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THE EFFECT OF EXERCISE ON PHYSICAL FITNESS, PHYSICAL
SELF-EFFICACY, PHYSICAL COMPETENCE,
PHYSICAL ACCEPTANCE, SELF-ESTEEM, LOCUS OF CONTROL,
AND HOPE

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND
RESEARCH IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF SCIENCE

by

JEANINE MARIE GLASSFORD



PHYSICAL EDUCATION AND SPORT STUDIES

EDMONTON, ALBERTA
SPRING 1992



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THE UNIVERSITY OF ALBERTA
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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled THE EFFECTS OF EXERCISE ON PHYSICAL FITNESS, PHYSICAL SELF-EFFICACY, PHYSICAL COMPETENCE, PHYSICAL ACCEPTANCE, GLOBAL SELF-ESTEEM, LOCUS OF CONTROL, AND HOPE submitted by Jeanine Marie Glassford in partial fulfilment of the requirements for the degree of MASTER OF SCIENCE.

Quinn

Supervisor

Rtg. Jeanne

2/6/92

Date *April 21 1992*

DEDICATION

"The truth of things is after all their living fulness, and some day, from a more commanding point of view than was possible to any one in (a previous) generation, our descendants, enriched with the spoils of all our analytic investigations, will get round to that higher and simpler way of looking at things."

-William James

To my husband, Greg, for his support, encouragement, endless patience, and computer know-how throughout; to my parents for their encouragement, expertise, and interest in the journey that became this thesis; and to my son, Benjamin, who has taught me something of a "higher and simpler way of looking at things."

ABSTRACT

The present study was designed to permit a comparison of the effects of an 8 week exercise program upon physical fitness measures, physical self-efficacy, physical competence and acceptance, self-esteem, locus of control and hope in sedentary women to the same measurements in a Control group of sedentary women. The purpose of the study was to test Sonstroem and Morgan's model for the relationship between exercise and self-esteem with sedentary, non-symptomatic women. This model suggests that improvements in activity-specific competencies will generalize to improvements in self-esteem following exercise. In addition, an attempt was made to determine whether locus of control and hope changed following exercise intervention, and whether locus of control played a role in Sonstroem and Morgan's model.

The participants were randomly placed into a Control group (C) (16 participants) and an Exercise group (E) (19 participants). The age range was between 23 and 60 years of age. Pre- and post-intervention measures were taken for body weight, skinfold measurements, girth measurements, flexibility, grip strength, sit-ups, push-ups, predicted V02 maximum, physical self-efficacy, physical competence, physical acceptance, self-esteem, locus of control, and hope.

Significantly greater changes ($p < 0.05$) were found in the E group over time in suprailiac skinfold measures, push-ups, sit-ups, predicted V02 max, self-efficacy, competence, acceptance, and hope.

Results from the 8 week program indicated that while Sonstroem and Morgan's model was not corroborated in the present study, there was a significant change ($p < 0.05$) in two of the competency measurements (i.e. physical self-efficacy and physical competence) and in physical self-acceptance following exercise intervention, as the model predicted. However, these improvements in competency did not generalize to improved self-esteem following exercise, as predicted by Sonstroem and Morgans's model. There was also no significant correlation between physical fitness, self-efficacy, competence, acceptance, or self-esteem following exercise, contrary to the model predictions. Surprisingly, significant correlations between variables in the Control group more closely approximated the relationships predicted by the model.

Locus of control did not change significantly following exercise; it did not

appear to play a role in the model.

Hope increased significantly following exercise.

Within the limitations of the study, it was concluded that:

1. An 8 week, moderate exercise program was associated with an improvement in predicted V02 max and muscular strength and endurance.
2. An 8 week exercise program was associated with significant increases in physical self-efficacy, physical competence, physical acceptance, and hope.
3. Measures of self-efficacy for aerobic activities were more highly correlated with measures of cardiorespiratory fitness; self-efficacy appears to be activity-specific. Participation in exercise did not strengthen this relationship.
4. Sonstroem and Morgan's model was not corroborated for sedentary women in the present study. This may be due to the relatively short duration of the program; self-esteem may change following exercise with longer exposure to the intervention. Long-term follow-up may reveal changes not evident immediately following the intervention.
5. Large variance due, in part, to the substantial age range of the participants, may have rendered it more difficult to achieve statistical significance in some cases.
6. Due to seasonal activity level changes, the Control group may have become more active during the intervention period than they were at pre-intervention assessment.
7. Following participation in the exercise program, the E group may have become more critical of their physical abilities, resulting in less accurate assessment of personal competencies. With a longer program, it is possible that perception of competence may have more accurately reflected reality.
8. Greater insight into the relationship between exercise and self-esteem, and into the nature of self-esteem might be gained by assessing the value participants place upon self-conception measures in the model. Assessment of the value participants place upon all sub-areas of self-concept (i.e. intellectual, social, emotional, along with physical) might also render greater insight into the self-esteem construct.
9. Assessment of the contribution made by social and other factors in the exercise program to the self-conception measures in the model may provide insight into the relationship between exercise and self-conception measures.

10. Exercise was associated with an increase in hope in sedentary women in the present study; this may be due to increased optimism, sense of personal competence, mutuality or relationship with others in the exercise program, and improved coping strategies for stress.

11. Significant (and strong) correlations between global self-esteem and hope for both groups and at pre- and post-intervention suggest that self-esteem may be part of the hope construct for sedentary women in the present study.

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"A teacher.....can never tell where his (her) influence stops."

Henry (Brooks) Adams

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I. INTRODUCTION

Physical activity as a specific documented treatment intervention is a relatively new concept. As such, the reported benefits of therapeutic exercise treatments for a variety of both physical and psychological disorders is equivocal. Results from research chronicling the effect of exercise upon psychological parameters in non-symptomatic populations is also ambiguous. According to a number of researchers, part of the difficulty in obtaining reliable and valid results concerning relationships between physiological and psychological conditions stem from inadequate theoretical models (Hughes, 1984; Sonstroem and Morgan, 1989). However, as research continues in the field of exercise science dealing with the effects of exercise upon psychological conditions, methods and theoretical frameworks amenable to this field of investigation become more specific and defined.

Ample evidence exists documenting the positive effects of exercise upon physiological function. For example, there is a large body of literature exploring exercise as a treatment intervention for reducing coronary risk and some studies have claimed beneficial results from the therapeutic use of exercise in treating hypertension. Recently, work has begun investigating the benefits of exercise with cancer patients based upon promising results with the animal model. For example, studies have recently revealed that exercise is associated with receding cancer tumours in rats (Baracos et al., 1989; Cohen, 1988).

A pilot study with lung cancer patients suggested both psychological and physiological benefits following the exercise program. This study demonstrated improvements in physiological function in all areas (i.e. cardiovascular, muscular strength and endurance, flexibility). The effect of the exercise program upon the actual tumour growth was not assessed. The participants appeared to have an increased sense of hope, of control over their bodies and their lives (internal locus of control), and improved self-esteem. These observations were qualitatively 'measured' by informal discussion over the 16 week course of the exercise program and physiological testing. This pilot project sparked an interest in the role exercise plays in psychological function and how physical changes and psychological changes interact following exercise intervention.

It is difficult to draw meaningful conclusions from this study because the assessment of psychological change in the lung cancer patients participating in the pilot study was conducted informally (primarily through discussion and

observation). However, there did appear to be an association between improved physiological function (as the exercise program progressed) and improved perceived internal locus of control. All participants noted that they felt much better about themselves both physically and psychologically as the exercise program progressed. It appeared that the exercise program was associated with an improvement in a number of psychological parameters, including self-esteem, along with the physiological improvements.

As with the aforementioned pilot study, a significant amount of the research investigating the effect of exercise upon psychological function has produced equivocal results. It is postulated (and in some cases assumed) that psychological and emotional benefits accrue from chronic exercise. Enough studies have chronicled a positive relationship between exercise and improved psychological function (amongst parameters such as depression, anxiety, cognitive function, self-esteem, self-concept, self-efficacy, mood, and mental well-being) to invite rather than discourage more in-depth study of this relationship. But as Sonstroem and Morgan assert, further investigation should expand the research from the simplistic question "Is there a relationship between exercise and improved psychological function?" to encompass explanations for this relationship (should it occur). Explanations for the relationship between exercise and a change in psychological function would be most helpful if they included both the nature and the process of that change (Sonstroem and Morgan, 1989).

In their ongoing search for solutions to this puzzle, Sonstroem and Morgan (1989) have devised a model based upon a comprehensive literature review and their own large body of research. This model suggests a structure responsible for the improvement in global self-esteem observed in some individuals following participation in an exercise program. Hence, Sonstroem and Morgans' rationale and model for exercise and self-esteem attempts to redress the problem that "...research in this area tend(s) to be simplistic in self-esteem theory and measurement and remain(s) incapable of addressing how or why change occur(s)" (1989, p. 329). They argue further that "...the understanding and planning for self-esteem change through exercise" is inhibited by a dearth of theory and inadequate explanations for the mechanism of change (Sonstroem and Morgan, 1989, p. 329). Their model and rationale incorporates physical self-efficacy, physical competence and physical acceptance (key components of self-concept), and self-esteem in a hierarchical

manner with exercise intervention as the proposed catalyst sending the subject up the hierarchy to improved self-esteem. Their model focusses upon "...self-esteem enhancement via the generalization of perceived competencies developed at fitness activities..." (Sonstroem and Morgan, 1989, p. 336).

Along with self-esteem, locus of control and hope are two other elements that appeared to change with an increase in exercise among the lung cancer pilot study participants. In a second project with battered women, both hope and locus of control were measured along with the parameters outlined in Sonstroem and Morgan's model. In this investigation, both locus of control and hope changed significantly following exercise intervention.

While a literature review has not revealed any studies chronicling the relationship between exercise and hope, it appears to be worthy of closer scrutiny. Long (1984 and 1985) and Long and Haney (1988 and 1988) reported a decrease in anxiety levels and increased optimism following aerobic conditioning in their research; Staats (1989) suggests that optimism for the future is an integral component in hope. Sonstroem and Morgan's model (1989) suggests that exercise can improve self-concept. According to Obayuwana and Carter (1982), ego strength (i. e. self-concept) is one of the components of hope. And the reported anxiety-reducing aspect of exercise participation could increase perception of hope by contributing to one's ability to cope with stress.

Studies investigating the relationship between exercise and locus of control generally reveal a shift to greater internal locus of control (i.e. increased sense that consequences of action can be attributed to oneself) following exercise participation. And perhaps locus of control, along with self-efficacy and self-concept, is a potential agent of change mediating improvement in self-esteem following exercise intervention.

A. THE PROBLEM

Investigations of the relationship between exercise and self-esteem require a more systematic approach than has been adopted, by and large, in the past (Sonstroem and Morgan, 1989). Additionally, there is a dearth of studies investigating the relationship between self-esteem in women and exercise (or any other intervention, according to Sanford and Donovan, 1984). To bring what appeared (from the literature review) to be the most

comprehensive and systematic approach to a study of the relationship between exercise and self-esteem among women, Sonstroem and Morgan's model was selected for this investigation. The fundamental question addressed by this study was "Does exercise improve global self-esteem in a normal population of women?" From this fundamental question, a number of spin-off issues were tackled. If a change in global self-esteem occurred, a number of other questions arose: the first of these was to discern whether an actual improvement in physiological function (as measured by improved physical fitness), or perceived improvement in physiological function, or simply the act of engaging in physical activity was associated with improved self-esteem. These include the question of whether a change in physiological function is necessary to improve global self-esteem (should this improvement occur) or whether perceived improvement in physiological function is necessary regardless of measurable changes. The second question was whether a change in the mediating factors (self-efficacy, self-concept) occurred along with a change in global self-esteem. The third was whether the changes in mediating factors occurred at approximately the same rate or whether one factor appeared to improve more and/or at a similar rate to the improvement in self-esteem. To paraphrase, the present study tried to determine whether Sonstroem and Morgan's theoretical model is valid with a non-patient population of sedentary women by determining how the components of self-efficacy, self-concept, global self-esteem, and physical fitness correlate and covary.

In the rationale for their model, Sonstroem and Morgan claim that a global self-esteem change following exercise intervention is a result of a change that occurs in two other factors: self-efficacy and self-concept, and that there is a systematic, hierarchical (and causative) change. Following exercise intervention, a change in the base (perceived physical self-efficacy) causes a change in physical self-concept (measured in the present study with components of physical self-concept, physical competence and physical acceptance) which leads to a change in global self-esteem (Sonstroem and Morgan, 1989). Essentially, the third question in the present study asks whether, if there is an improvement in global self-esteem, this improvement is coincident with improvements in physical fitness (perceived or otherwise) which generalizes to improved self-efficacy, then improved self-concept, and improved global self-esteem.

Another component that was investigated was the role locus of control played in the relationship between exercise and self-esteem. More specifically, the question investigated was whether the participants' sense of internal control improved following the exercise program, and whether it improved in a similar way as self-efficacy, self-concept, and self-esteem. The aim of this line of study was to examine whether locus of control is a mediating factor in improving global self-esteem, and whether it is measurable physical fitness or perceived physical fitness that is associated with an improvement in locus of control.

Finally, the concept of hope and the role exercise may play in enhancing hope was investigated. In summary, the purpose of this study was to examine the effects of an exercise program upon global self-esteem and physiological function in a sedentary population of women, using Sonstroem and Morgan's (1989) model as a theoretical framework.

B. RATIONALE

As Sanford and Donovan state, "We need self-esteem because nothing is as important to psychological well-being" (1984, p. 3). Most researchers in this field of study agree that self-esteem is central to the subjective life of the individual, affecting thoughts, attitudes, feelings, behaviours, and abilities (Coopersmith, 1967; Gardner, 1947; Rosenberg, 1965 and 1979; Sanford and Donovan, 1984). Throughout history, individuals such as Jean Jacques Rousseau, Ernest Becker, and Alfred Adler have attested to the significance of self-esteem. For example, in his book The Birth and Death of Meaning, Becker stated that self-esteem is the dominant motive of man (1971). Thirty years before Becker, Adler quoted that the supreme law of life should be that "...the sense of worth of the self shall not be allowed to be diminished" (cited from Ansbacher and Ansbacher, p. 358, 1946). It is likely that any treatment intervention that can enhance a construct as central as self-esteem could prove advantageous in a number of health fields.

In their book Women and Self-Esteem, Sanford and Donovan note that there is a paucity of research on women and self-esteem, yet what studies there are (and based upon their own clinical experience) reveal a pattern of low self-esteem among a substantial number of women. Explanations for this observation are complex but relate, according to Sanford and Donovan, to women's social status. While changes are occurring at this level, there are

vestiges of what Sanford and Donovan refer to as 'androcentrism' which colour the research conducted in this area to date. For example, questionnaires devised by both Coopersmith and Rosenberg (leading authorities in America on self-esteem) to measure self-esteem are based upon studies of male students, male children, and male adolescents. From these studies, generalized statements about human psychology are made. No studies have been done to date to investigate whether Rosenberg's and Coopersmith's work is equally applicable to females as to males. However, with these limitations in mind, it is evident that further research on self-esteem in women is necessary to better elucidate this relationship (Sanford and Donovan, 1984). As Sanford and Donovan state, "although other writers have examined some of the more obvious symptoms of low self-esteem among women (e.g., depression, nonassertiveness, negative body image), the root cause of these symptomatic manifestations - namely, lack of self-esteem - remains inadequately explored" (p. xiv, Preface, 1984). For these reasons, the present study involved a population of women.

According to some researchers, among the numerous psychological parameters investigated, self-esteem is the variable most appropriate for the study of the effect of exercise upon psychological states (Folkins and Sime, 1981; Hughes, 1984; Sonstroem, 1984). As Folkins and Sime (1981) and Hughes (1984) state, self-esteem has the greatest potential for benefit from physical activity. Because individuals' self-esteem appears to be amenable to positive change following participation in an exercise program, and because self-esteem has been cited as an important component in an individual's life, this was one of the constructs chosen for the present study.

Exercise as a therapeutic intervention is beginning to gain credence for more than cardiac rehabilitation. Exercise as a coping mechanism may act as a complement to its purported self-esteem improvement function. Additionally, exercise has been cited frequently in the literature as a stress-reducing activity, perhaps by providing a positive coping mechanism. Generalized stress reactions can produce psychophysiological disease, in part perhaps due to a compromised immune system following stress (Walker, 1989, p. 177). As Rosenberg's research reveals, people with low self-esteem report significantly more psychosomatic symptoms often indicative of a stressed system, such as "...nervousness, loss of appetite, insomnia, and headaches..." (p. 25, 1965). Hence, exercise as a coping mechanism (as well as its professed anti-anxiety

and anti-depressant program) might not only complement its (suggested) self-esteem improving function but may benefit anyone with undue anxiety problems or low self-esteem. Further research is necessary to examine the relationship between exercise, self-esteem, and the stress response, first to determine whether exercise improves self-esteem and a stressed system, and second to elucidate the nature of this relationship. More specifically, the present study aimed to investigate how exercise might improve self-esteem (if, in fact, this relationship exists) and where (or whether) stress reduction associated with exercise has a role in the relationship between exercise and self-esteem.

As was mentioned in the Introduction, exercise as a therapeutic intervention is beginning to gain credence for more than cardiac rehabilitation. However, exercise as a treatment intervention appears to be more successful with population groups exhibiting compromised psychological function or disorders as opposed to "normal" populations or athletes. For example, Dishman (1986), Doyne et al. (1987), Folkins and Sime (1981), Hughes (1984), and many others have found that exercise tends to improve negative mood states such as depression and anxiety. Controlled studies with normal populations have not shown clear response patterns. And because of the homogeneity of many of their subject populations (i.e. many are college students), some researchers argue that the generalizability of the results of these studies is suspect (Moses et al., 1988). While making no claims that the population participating in this study was representative, an attempt was made to study a population of normal, sedentary women.

A population of normal, sedentary women was chosen as the target population for this study in an attempt to test Sonstroem and Morgan's model for exercise and self-esteem (1989). As mentioned in the Introduction, theory explaining the effect of exercise upon self-esteem is weak (Sonstroem and Morgan, 1989). Sonstroem and Morgan's proposed model seeks to bring a systematic approach to the study of the relationship between exercise and self-esteem and hence better explain this relationship. To this end, Sonstroem and Morgan's model for exercise and self-esteem suggests that self-esteem may be enhanced following participation in an exercise program by first improving physical self-efficacy, which may contribute to improved self-concept (measured by perceived physical competence and by physical acceptance) which might then improve global self-esteem. Sonstroem and Morgan's (1989) model was chosen for the present study because it exhibited the most

comprehensive and systematic approach to research in exercise and self-esteem. As such, results from an investigation into the relationship between exercise and self-esteem might render greater insight into the nature of this relationship.

Along with questionnaires assessing physical self-efficacy, self-concept (physical competence and physical acceptance), and self-esteem, a questionnaire assessing locus of control was given to participants. Based upon a number of researchers' results, it appeared that exercise can help to improve internal locus of control. To paraphrase, exercise was associated with a greater sense of control or 'empowerment' among participants which contributed to greater self-esteem. From these studies, it appeared that perceived control over one's life (internal locus of control) may be a mediating agent of change somewhere between improved physical self-efficacy and enhanced self-esteem in Sonstroem and Morgan's model (1989). Hence, a locus of control questionnaire was given to participants.

Herth's Hope questionnaire (1989) was also administered to the participants. Results from a pilot study with a population of battered women suggested that exercise participation had a positive impact on degree of hope measured. A number of questions arose from this study: Is there a change in hope in a normal population following exercise intervention? If so, is there a link between global self-esteem and hope (if there is a change in both) following exercise intervention? And if there is a change in hope, what aspect of hope, according to Herth's Hope Scale (i.e. Factor 1: Action Oriented Positive Expectancy, Factor 2: Relationship with Others and Sense of Personal Competency, and Factor 3: Temporality of Present Situation with Future Orientation) changes following exercise intervention? Previous research suggests that exercise might improve some of the indices of hope, including sense of personal competency or self-concept (through improved physical self-competence) (MacMahon and Gross, 1987; Roviato et al., 1984; Trujillo, 1983; Perri and Templer, 1985; Ossip-Klein et al., 1989; Short et al., 1984). And according to Coopersmith (1967), Epstein (1973), and Harter (1983 and 1985), physical competence is one of the components of global self-esteem. Exercise participation may also alter hope through its documented stress-reduction function.

Physiological tests measuring cardiovascular, muscular strength and endurance, body composition, and flexibility components of fitness were

administered to address a number of questions. One objective was to determine whether there were significant changes in physical fitness, and whether there was a pattern of change in fitness among sedentary women participating in the exercise program. A second objective was to determine whether the psychological benefits measured were associated with physical activity but not an actual change in physical fitness. According to some researchers, the perception of physical fitness is a better determinant of improved self-efficacy; if an individual improves their fitness level but is not aware of it, some researchers argue that self-efficacy will not change (Bandura, 1977 and 1982).

C. LIMITATIONS

- 1) While the physiological tests were all conducted in the same room and at the same time of day, temperature and humidity were not controlled in testing and/or the exercise areas.
- 2) The eight week physical exercise program was conducted during the late spring/early summer. As this is typically the time of year that people increase their physical activity level, the control group reported an increased amount of physical activity participation in their spare time.
- 3) The sample of subjects were volunteer.
- 4) Due to time constraints, a physical competence scale specific for the population was not devised (nor were principal component or confirmatory factor analyses run with data obtained from a target population). Instead, a scale discussed in Sonstroem and Morgan's model and rationale (1989) was used.
- 5) Due to the volume of questionnaires administered to the participants, measures of the value or importance participants placed upon components of self-concept in the model (as suggested by Dickstein, 1977; Marsh, 1986; Messer and Harter, 1986; Sonstroem and Morgan, 1989; and others) were not assessed.
- 6) Due to the timing of the study, the exercise program was conducted for 8 weeks rather than 16 weeks (as originally planned). Sonstroem and Morgan (1989) have indicated that a program duration of 15 to 20 weeks might have a greater impact on "broader trait" variables (e.g. self-esteem) and "in terms of the effect of experience on the accuracy of more specific self-perceptions" (p. 333).

7) Due to the volume of data collected, the effect of "program agents" (i.e. elements in the exercise program such as social factors, feedback, etc.) on the psychological parameters was not assessed.

D. DELIMITATIONS

This study was delimited to:

- 1) Forty-eight university community volunteer female subjects. Forty-six of the forty-eight were non-academic staff; one was a graduate student and one was recently self-employed. The participants ranged in age from twenty-three to sixty with a mean age of 41 years.
- 2) The exercise program was conducted three times per week for eight weeks by the same instructor, in the same venues, and at the same time of day for the duration of the program.
- 3) The participants were randomly assigned to an exercise group of twenty-four participants and a control group of twenty-four participants. Attrition accounted for approximately a 27% decrease in participants; during the study, six participants (25%) withdrew from the exercise group and eight (30%) withdrew from the control group for a variety of reasons.

E. NULL HYPOTHESIS

The following hypotheses were tested for significance at the 0.05 level of probability:

If group 1 represents a Control group receiving no exercise program, and group 2 represents an Exercise group receiving a moderate exercise program, then:

There is no difference in the effects of the experimental conditions on the physical fitness, physical self-efficacy, physical competence and physical acceptance, self-esteem, locus of control, or hope of sedentary women. There is no relationship between the physical fitness, physical self-efficacy, physical competence, physical

acceptance, self-esteem, locus of control, or hope in any of the groups investigated.

The null hypothesis statement is as follows:

$$\text{Ho: } \mu_{\text{CPre}} = \mu_{\text{EPre}} = \mu_{\text{CPost}} = \mu_{\text{EPost}} \quad \text{and} \\ \text{Ho: } r_{\rho} = 0$$

F. DEFINITION OF TERMS and ABBREVIATIONS

Some of the research reviewed for the present study define the pertinent psychological and physiological parameters vaguely at best, and hence compromise the results. Ambiguous terminology may contribute to what Sonstroem and Morgan refer to as a "present lack of theory emerging from exercise studies" of self-esteem change through exercise (p. 329, 1989). For example, improved "self-concept" and improved "self-esteem" are terms that are frequently mentioned and are occasionally used interchangeably (Sonstroem and Morgan, 1989). As Wells and Marwell (1976) assert, the seeming interchangeability of the terms self-concept and self-esteem can be attributed to both convenience and the related nature of the terms. However, as Sanford and Donovan (1984) state, these terms are not interchangeable. As these researchers say, a clear definition of the terms goes a long way toward clarifying the issue.

Adaptation: A more or less persistent change in structure or function, especially as caused by repeated bouts of physical exercise.

Aerobic Capacity: A functional measure of physical fitness based on the measurement of maximal oxygen uptake. Generally synonymous with the terms maximal oxygen uptake and cardiorespiratory endurance.

ANOVA: Analysis of variance.

Body Composition: A measure of body fat, based upon skinfold measurements taken from various body sites, including triceps, biceps, subscapular, iliac crest, suprailiac, abdominal, front thigh, and medial calf. An indirect indicator of the proportions of fat and lean constituents in the body.

Body Density: The weight of the body per unit volume; typically expressed in grams per cubic centimeter.

CV function or Cardiovascular Function: Refers to the efficiency and capability of the circulatory system to handle the stress of an increased load brought on by exercise. In this study, CV function was measured with modified physical work capacity (PWC: Sjostrand 170) cycle ergometer test. This test allows the investigator to estimate maximal oxygen consumption ($\dot{V}O_2$ Max).

Exercise program: Refers to a period of supervised physical activity engaged in three times per week for eight weeks.

Flexibility: The range of movement of the body's joints and corresponding muscle groups. In this study, the flexibility of the hamstring and lower back muscles was measured with the sit and reach test.

Hope: According to Obayuwana and Carter (1982), for practical purposes, "...hope can be defined as the state of mind resulting from the positive outcome of ego strength, religion, perceived human family support, education, and economic aspects," (p. 232, 1982). Herth (1989) incorporates Lazarus and Folkman's theory in her theoretical framework for hope. According to Herth, hope involves "...primary and secondary appraisal. Primary appraisal is the cognitive determination of the degree of threat to the individual; secondary appraisal is the individual's coping mechanisms" (1989, p. 67). The Herth Hope Scale (1989) divides hope into three factors: action-oriented positive expectancy, mutuality (relationship with others) and sense of personal competency, and temporality of present situation with future orientation.

Kilopond-meter (kpm): The work done when a mass of one kilogram is lifted one meter against the force of gravity.

Lean Body Mass: The body mass that does not include fat tissue; the body weight minus the per cent of body weight that is stored fat.

Locus of Control: "Internal-external locus of control refers to the extent to which persons perceive contingency relationships between their actions and their outcomes" (Robinson and Shaver, p. 169, 1973). Individuals that attribute outcome to action extrinsic to themselves (e.g. the unpredictable, chance, luck, powerful others, fate, etc.) are termed 'externals' and those who believe that they are responsible for some control over their lives are considered 'internals.'

Maximal Oxygen Uptake: Also maximal oxygen consumption, $\dot{V}O_2$ max., maximal oxygen uptake, maximal aerobic power. The greatest volume of oxygen used by the cells per unit of time. In the present study, maximal oxygen uptake was predicted with the Sjostrand PWC₁₇₀ cycle ergometer test.

Muscular Strength and Endurance (MSE): Refers to the subject's capacity to exert a quantity of muscular work or force against a resistance (strength) and the capacity to exert a force repeatedly without fatigue (endurance). In this study, MSE was measured with functional tests (sit-ups and push-ups) in which muscular endurance had greater opportunity for change (i.e. the number of sit-ups and push-ups performed changed) than did muscular strength (the load did not change significantly in performing the sit-ups or push-ups).

Sedentary: For the purpose of this study, a person was considered sedentary if, in the past six months, she had not engaged in physical activity beyond that required for daily living.

Self-Concept: As Rogers defines it, self-concept involves conscious awareness of the structure of the self, or "...organized configuration of prescriptions of the self..." (p. 379, 1950). Sanford and Donovan (1984), Rosenberg (1979), and Coopersmith (1967) refer to the self-concept (or self-image) as "...the set of beliefs or images we all have and hold to be true of ourselves" (as opposed to self-esteem, which is a measure of "...how much we like and approve of our self-concept") (Sanford and Donovan, p. 7, 1984). In Sonstroem and Morgan's model (1989), components of physical self-concept include sport competence, physical condition, attractiveness of the body, and physical strength (according to research done by K.R. Fox, who has identified these components of the physical self in college students; "validated physical competence scales for people in their middle years do not exist at present")

(Sonstroem and Morgan, 1989, p. 334). Physical competence and physical acceptance, components of self-concept, are defined below.

Physical Competence: refers to regard for the body (including its abilities, appearance, and function) (Coopersmith, 1967; Epstein, 1973; Fitts, 1965; Messer and Harter, 1986; Secord and Jourard, 1953). According to Sonstroem and Morgan, physical competence "...refers to a general evaluation of the self as possessing overall physical fitness" (p. 344, 1989).

Physical Acceptance: as an important part of self-concept, physical acceptance can be considered by a measure of satisfaction with the body and its parts and processes (Mahoney and Finch, 1976; Rosenberg, 1979; Secord and Jourard, 1953; Wylie, 1974).

Self-Efficacy (Perceived): According to Bandura, the exercise of control over function is founded on the individual's self-perceptions of efficacy (1986). Perceived self-efficacy involves the level and strength of the individual's belief that she or he can perform a specific activity successfully (Bandura, 1977 and 1982). Physical self-efficacy is a component of perceived self-efficacy and is defined below:

Physical Self-Efficacy: is a competence judgement specific to an activity performed. Physical self-efficacy refers to the perceived ability to perform a specific task; physical competence is a more general perception.

Self-Esteem: While self-esteem and self-concept have been used interchangeably (Wells and Marwell, 1976), there are fundamental differences in the terms which distinguish them. Self-concept denotes a more conscious, self-aware, and self-structuring component. Self-esteem refers to one's "personal judgement of worthiness" (Coopersmith, p. 5, 1967). In short, self-esteem is the reputation individual's have with themselves (Sanford and Donovan, 1984). Self-esteem can be divided into two types: global and specific, which are defined below:

Global Self-Esteem: refers to how much individuals like and approve of their perceived selves as a whole.

Specific Self-Esteem: refers to how much an individual likes and approves of certain parts of themselves. An individual's global self-esteem will be enhanced by specific self-esteem if he or she places a great deal of value upon that specific aspect of him or herself.

II. REVIEW OF THE LITERATURE

Based upon the research conducted to date, it is difficult to draw firm conclusions about the relationship between exercise and the psychological variables considered in this study and the role physical changes due to exercise participation play in these relationships. However, a review of the literature points to the directions in which this field of investigation are progressing. Sonstroem and Morgan (1989) have devised a model and suggested a rationale for the relationship between exercise and self-esteem. As (what appears to be) the most systematic and comprehensive approach to this relationship, Sonstroem and Morgan's model for exercise and self-esteem was the model tested in the present study. The various aspects of the relationship between exercise and self-esteem will be reviewed under the following headings: a) the effect of exercise on self-efficacy; b) the effect of exercise on self-concept; c) the effect of exercise on self-esteem; d) perceived or actual changes in physical fitness: which are associated with changes in psychological variables?; e) Sonstroem and Morgan's model: suggested mechanism for change; f) effect of exercise on locus of control; g) effect of exercise on other psychological variables; and h) the relationship between exercise and hope - exercise as a coping strategy for stress.

A. THE EFFECT OF EXERCISE ON SELF-EFFICACY

Because of the paucity of studies conducted investigating the effect of exercise on self-efficacy, this review will not be confined to reports with normal populations but will consider reports concerning any populations. This holds true for the other psychological parameters and issues discussed in this review of the literature as well.

The relationship of self-efficacy to action of any kind is cyclical. Not only is behaviour influenced by self-efficacy expectations, the latter are influenced by the success of behaviour (Bandura, 1977 and 1982). According to Bandura, the exercise of control over function is founded on the individual's self-perceptions of efficacy (1986). Through the exercise of personal agency, the individual's perception of their own abilities affects motivation and action. According to Sonstroem and Morgan, it has been postulated that perceived self-efficacy is a

"...cognitive mediator underlying all therapies attempting psychological change" (Sonstroem and Morgan, p. 332, 1989).

A number of studies cite self-efficacy as a predictor of health and exercise behaviour change and maintenance. For example, Strecher et al. (1986) found that with experimental manipulations of self-efficacy, this parameter can be enhanced with a subsequent improvement in health behaviours such as exercise, weight control, smoking, substance abuse, etc. They suggest that improving self-efficacy can enhance health practices (Strecher et al., 1986). Sallis et al. (1988) also found that self-efficacy factors were significantly associated with reported diet and exercise behaviour. Like Strecher et al., Stanley and Maddux (1986) reported that self-efficacy expectancy was the best predictor of health behaviour intentions.

Desharnais et al. (1986) have found that self-efficacy may be a central determinant in not only exercise intention, but exercise adherence. Outcome expectancy and self-efficacy were both found to be cognitive mediators of exercise adherence.

In their investigation of the role of self-efficacy perceptions as a mediator for the adoption of new or difficult physical activities, Ewart et al. (1986) found that cardiac patients improved physical self-efficacy scores following circuit weight training and volleyball training. More specifically, they found that greater strength and endurance gains were reported for circuit weight trainers and these were accompanied by an increase in self-efficacy for activities resembling the training tasks (Ewart et al., 1986).

Tappe and Duda (1988) found that personal investment was the best predictor (significantly more powerful than self-efficacy or participants' goals) for 'life satisfaction' among physically active older adults. However, both Weitzman's (1980) and Tappe and Duda's (1988) investigations measure vague psychological variables such as "perceptions of a sense of self," "ego motivation," and "physiological motivation" which renders their results more difficult to interpret.

From this brief review of studies investigating the role self-efficacy plays in enhancing health behaviour, it appears that Bandura's theory on the mechanism of personal agency is best supported by the literature. More specifically, Bandura's argument that the control of one's function is founded on self-perceptions of efficacy specific for each activity is better represented in the literature than the argument that the motivation to engage in health-promoting

exercise can be ascribed to global personality traits such as self-esteem (Bandura, 1986; Ewart et al., 1986).

If exercise behaviour depends to an extent upon a perception of efficacy, does the reverse relationship hold true? That is, does exercise enhance self-efficacy? Bandura suggests that exercise may provide "a series of graded mastery experiences that may enhance self-efficacy" (p. 158, 1977). Others take this suggestion further and postulate that this enhanced self-efficacy might improve coping ability and improve self-concept (Ossip-Klein et al., 1989; Beck et al., 1979). In her stress-management intervention studies with the chronically stressed, Long (1984 and 1985) and Long and Haney (1988 and 1988) found this was the case. In her first two studies, Long found that both aerobic conditioning and stress inoculation training improved self-efficacy and decreased anxiety. In their research, only the population of loggers improved their aerobic fitness levels. At three months follow-up, improved self-efficacy and reduced self-reported anxiety persisted but cardiovascular fitness dropped to original levels (Long, 1984 and 1985). Sonstroem and Morgan (1989) also refer to long-term measurements of physical and psychological parameters; with reference to their model, Sonstroem and Morgan suggest that measurements taken over time (i.e. one to two years) might reveal more about the relationship between exercise and self-esteem.

Long and Haney found similar results in their most recent studies of the effect of relaxation training versus aerobic exercise upon stressed working women (1988 and 1988). Trait anxiety decreased, self-efficacy improved, and the use of problem-focussed coping strategies increased. Cardiovascular fitness improved only in the aerobically conditioned. At long-term follow-up, psychological parameter changes were maintained and even strengthened. The proportion of women exposed to either aerobic exercise or relaxation training reaching clinically significant improvements in self-efficacy and reduced anxiety increased from 24% at the end of the eight week treatment to 36% at the end of the 14 month follow-up (Long and Haney, 1988). Ewart et al. (1983) also found physical confidence (self-efficacy) increased following exposure to exercise. They found that cardiac patients' perception of their capacity for physical activity and their actual patterns of subsequent physical activity were influenced by treadmill testing done three-weeks post-myocardial infarct. It is noteworthy that some investigators have reported that males tend to have higher perceived physical self-efficacy (Godin and Shephard, 1985).

What processes act to improve self-efficacy following exercise is the subject of some debate. As was mentioned earlier, Bandura argues that expectancies are specific and don't generalize. Hence, Bandura prefers to measure specific efficacy expectations (1977 and 1982). Others endorse the role of generalized expectancies measured by locus of control scales. In this study of the role of self-efficacy and perceived control as cognitive mediators of pain tolerance, Litt states that "...self-efficacy expectations can mediate desirability of providing control" (p. 149, 1988). Kaplan et al. (1984) did not find a clear association between an increase in perceived efficacy for walking (among chronic obstructive pulmonary disease patients exposed to a three month walking program) and an increase in generalized health locus of control measures. However, they did find that subjects expressed increased perceived efficacy for exercise behaviours similar to walking (Kaplan et al., 1984). This study, then, agrees with Bandura's theory that efficacy expectations don't generalize. Conversely, Atkins et al. (1984) and Holloway et al. (1988) found that improved self-efficacy did, indeed, generalize. Atkins et al. (1984) found that an improvement in self-efficacy following cognitive behaviour modification was correlated with an increase in general exercise behaviour, exercise tolerance, and health status. Holloway et al. (1988) reported that following 12 weeks of strength training, essentially sedentary women reported increased physical efficacy and self-esteem.

B. THE EFFECT OF EXERCISE ON SELF-CONCEPT

Important components of physical self-concept include physical competence, self-acceptance (a measurement of satisfaction with the body and its parts) (Secord and Jourard, 1953), physical appearance (Messer and Harter, 1986), and body consciousness (Miller et al., 1981). Regard for the body (including its abilities, appearance, and function) is an important part of self-concept (Coopersmith, 1967; Epstein, 1973; Fitts, 1965; Messer and Harter, 1986; Secord and Jourard, 1953). In their model of self-concept, Shavelson et al. (1976) incorporate a number of important components within a hierarchy leading to "general self-concept." According to this hierarchical model, self-concept is multi-faceted, consisting of intellectual/academic self-concept, social self-concept, emotional self-concept, and physical self-concept (Shavelson et al., 1976). As other researchers have reported, physical self-concept can be

further divided into physical ability and physical appearance (Shavelson et al., 1976). Not only is self-concept comprised of multiple components, but these components are not considered of equal value by the individual (Rosenberg, 1979; Watkins and Park, 1972). This should be taken into account in investigations concerning self-concept. For example, Watkins and Park found that multiplying the subjective importance of self-concept items before summing them led to a better correlation with body cathexis scores (1972). Finally, as Shavelson et al.'s (1976) model proposes, self-concept is hierarchically organized with situation-specific self-concept components at the base leading up to more generalized, global self-concept dimensions.

In studies examining the effect of exercise upon self-concept, some have found that specific improvements in self-concept have led to global improvements in self-concept. For example, in Ewart et al.'s (1983) study with postmyocardial infarction patients, physiological measures such as the graded treadmill test provided objective measures from which feelings of self-competence developed. Such 'competence judgements,' specific to the activity performed initially, generalized to feelings of greater physical self-competence with post-MI patients (Ewart et al., 1983; Taylor et al., 1985), with children (Harter, 1982; Marsh et al., 1983), and with college students (Marsh and O'Neill, 1986; Ryckman et al., 1982; and Safrit et al., 1986). According to Fox et al. (1985), physical estimation is a key factor in the relationship between self-esteem, physical fitness, and physical activity levels.

Conclusions from the studies conducted on exercise and self-concept can only be ambiguous due to the equivocal results evident in a review of the literature. For example, Trujillo (1983) found a significant improvement in self-concept following a 16 week exercise program among college women. Rainey and Wigtil (1985), on the other hand, reported no change in self-concept among college women. However, the exercise program outlined by Rainey and Wigtil appeared to be loosely controlled and measured. In their study of the effects of an aerobic exercise program upon psychological variables in older adults, Perri and Templer (1985) found that self-concept and internal locus of control increased significantly following a 14 week aerobic program. Similarly, Ossip-Klein et al. (1989) recorded a significant improvement in self-concept among clinically depressed women following a 10 week exercise program. Among adult obese males, aerobic fitness improved along with self-concept following an eight week physical conditioning program (Short et al., 1984). In Palmer et

al.'s study, following a four week exercise program, adult inpatient alcoholics showed significant improvements with state anxiety, trait anxiety, and depression, but not with self-concept and aerobic capacity (Palmer et al., 1988). This is not surprising; it is possible that four weeks of exposure to the exercise intervention was not adequate to enact a change in self-concept. Exercise physiology research shows that unless the program is intensive, four weeks of exercise is not usually enough to illicit a significant change in aerobic capacity.

In their study of boys with learning disabilities, MacMahon and Gross (1987) found that a 20 week aerobic exercise program were associated with an improvement in self-concept and physical fitness although there were no significant changes in academic achievement or motor proficiency. And in their study with delinquent adolescent males, the same investigators found an association between participation in aerobic exercise and improved self-concept, mood, and fitness (MacMahon and Gross, 1988). They qualified the results by stating that an improvement in psychological variables was not dependent upon improved physical fitness and was not related to pre-intervention measures. With cardiac patients, Roviato et al. found that a three month exercise program resulted in improved body concept, self-concept, decreased employment-related stress, and more active use and enjoyment of leisure time (1984). They reported that chronic cardiac patients benefited as much as acute patients, and that beneficial effects were evident four months later. Self-concept in children improved after participation in an eight week precision jump rope program even though physiological indices of body composition and cardiovascular fitness did not change (Hatfield et al., 1985). Ford et al. (1989) did not find an improvement in self-esteem, body cathexis, body fat, or step test scores among women exposed to eight weeks of exercise three times per week. In his review of the psychological effects of habitual exercise, Hughes (1984) reports little evidence for improvements in anxiety, depression, body image, personality, or cognition, but does conclude that exercise improves self-concept. Based upon his review of randomized, controlled studies of chronic aerobic exercise, Hughes (1984) argues that the only psychological variable that exhibited consistent improvement with exercise was self-concept. Hughes postulates that the mechanisms mediating an improvement in self-concept following exercise could include the subjects' response to perceived and/or actual fitness improvements.

In Sonstroem and Morgan's model (and based upon other research, such as Shavison's work with self-concept), physical competence and physical acceptance were suggested as indicators of physical self-concept. According to Coopersmith (1967), Epstein (1973), and Harter (1983 and 1985), physical competence is one of the postulates of the "general competence" dimension of global self-esteem. Epstein (1973) posits that the other three dimensions of global self-esteem include power, normal self-approval, and love-worthiness. Competence (or perceived self-control and the perceived ability to master aspects of the environment) may be an essential component of self-esteem. And physical activity may contribute greatly to an individual's perceived physical competence.

Physical activity may also contribute to improved physical acceptance. According to Crandall (1973), Dickstein (1977), and Secord and Jourard (1953), the best scale to measure body acceptance is the Body Cathexis Scale. Because 33 physical characteristics are included, individual and specific perceptions of the physical self can be accounted for. Only two studies were found addressing the relationship between physical activity, physical acceptance and self-esteem. Pollock et al. (1984) argue that exercise program design often encourages physical acceptance through supportive feedback and acceptance of individuals at every fitness level. Siberstein et al. (1988) reported that overall body esteem is correlated with self-esteem in their study with college-age males and females. The physical self-awareness component of physical activity is thought to contribute to improved physical acceptance as well. 'Body-awareness' or physical self-awareness has been suggested as an important factor in the self structure (Morgan, 1981; Morgan et al., 1983; Wicklund, 1975; Sanford and Donovan, 1984; and Sonstroem and Morgan, 1989).

C. THE EFFECT OF EXERCISE ON SELF-ESTEEM

The relationship between exercise and self-esteem has been alluded to under previous categories of the literature review. Self-esteem can be considered the degree to which individuals feel positive about themselves and as such implies a component of self-acceptance (Gergen, 1971; Rogers, 1950; Rosenberg, 1979; Sonstroem and Morgan, 1989). Not only does this suggest a connection between self-concept and self-esteem (through self-acceptance),

but it is likely that if physical activity can improve self-acceptance, it might also be associated with improved self-esteem. As has been mentioned in the Introduction, results in some studies have been compromised due to ambivalence in the definition of terms. For example, Rainey and Wigtil (1985) and Trujillo use the Tennessee Self-Concept Scale (a scale designed to measure self-concept, as its name suggests) to measure what is referred to as 'self-esteem.' The two terms are inter-related, but still distinguishable. For example, Weinhold and Hilferty (1983) describe the self-esteem matrix in terms of four skill areas necessary for developing and maintaining high levels of self-esteem: 1) an ability to make "...meaningful contact with one's inner self and others"; 2) an ability to "...accept differences in oneself and others"; 3) an ability to exercise "...influence over one's life space" and 4) an ability to "...maintain a constant sense of identity" (Weinhold and Hilferty, p. 250, 1983). If this definition can be considered applicable to self-esteem, physical activity may play a role in enhancing self-esteem in any or all of these skill areas. However, Weinhold and Hilferty's definition may address the precursors to high self-esteem, but not self-esteem itself.

Low self-esteem and lack of self-acceptance (sense of worthlessness) is often cited as a characteristic of mental instability (Horney, 1950; Fromm, 1956), and is considered by some as an indication of emotional maladjustment (Sonstroem and Morgan, 1989). Depression and chronic and/or trait anxiety are associated with low self-esteem (Coopersmith, 1967; Hill, 1968; Pilisuk, 1963; Rosenberg, 1979; Wilson and Krane, 1980; Wylie, 1979).

As with self-efficacy and self-concept, the effect of exercise upon self-esteem is not clear, based upon a review of the literature. A number of researchers report a positive relationship between exercise and self-esteem. For example, while Hinkle (1988) does not elaborate upon self-esteem theory, he does review studies indicating that aerobic exercise has anti-depressant and anti-anxiety effects. He also concludes that exercise is beneficial to self-esteem and creative thinking and recommends psychotherapeutic running programs (Hinkle, 1988). Similarly, Chastain and Shapiro (1987) found that following a six week exercise program, in patients with mental disorders experienced enhanced self-esteem and body image. Finocchiaro and Shmitz (1984) reported that exercise facilitated an increase in self-esteem and a decrease in depression among depressed and emotionally disturbed adolescents. In their study with college-age males and females, Siberstein et al. (1988) reported that

overall body esteem was correlated with self-esteem. And according to Fox et al. (1985), physical estimation is a key factor in the relationship between self-esteem, physical fitness, and physical activity levels.

Sanford and Donovan (1984) and others have found that a cyclical relationship exists between self-esteem and other psychological variables. For example, high self-esteem might better predict physical acceptance and self-efficacy. Similarly, Weitzman (1980) found that blind people engaged in exercise more readily if their self-esteem had been enhanced prior to exposure to activity by instructor intervention.

Conversely, Nagy and Frazier (1988), Netz et al. (1988), Munson et al. (1985), and Munson (1988) reported no significant changes in most psychological parameters following exercise intervention. Netz et al. (1988) reported no change in self-esteem, body image, or trait anxiety among older adults following a 12 week activity program. They did not find improved sense of well-being. Munson et al. (1985 and 1988) found no significant change in self-esteem among juvenile delinquent males following a strength training program. In their study of the impact of exercise upon locus of control, self-esteem, and mood states among college women, Nagy and Frazier (1988) found no significant differences.

Alternatively, Morgan (1985) examined the acute rather than the chronic effects of exercise upon self-esteem. He reports that following exercise, state anxiety decreased and that this benefit can persist for two to five hours. Conclusions from Morgan's review of the literature support other researchers' conclusions: that chronic physical activity is associated with a decrease in anxiety and depression and an improvement in self-esteem. But as Morgan asserts, it is not clear whether exercise causes any change in psychological parameters or whether exercise is merely associated with changes in psychological parameters (1985).

D. PERCEIVED OR ACTUAL CHANGES IN PHYSICAL FITNESS: Which are Associated with Changes in Psychological Variables?

Based upon the literature review, it is difficult to discern whether an actual improvement in physical fitness or the act of engaging in physical activity is responsible for improved self-efficacy, self-concept, and/or self-esteem. For example, Long found that while aerobic conditioning improved cardiovascular

fitness concomitantly with an improvement in self-efficacy and a decrease in anxiety, the psychological improvements persisted and strengthened after three months while the physiological benefits did not persist (Long, 1984; 1988). While most studies reporting improved psychological parameters following exercise also reported improved physical fitness, some studies found psychological benefits were associated with physical activity but no change in physical fitness (e.g. Finocchiaro, Shmitz, 1984; Netz et al., 1988; MacMahon, Gross, 1988; Hatfield et al., 1985). According to Bandura, the perception of physical fitness is a better determinant of improved self-efficacy; if an individual improves their fitness level but is not aware of it, Bandura argues that self-efficacy will not change (Bandura, 1977 and 1982). In their research with delinquent adolescent males, MacMahon and Gross (1988) found that an improvement in psychological variables (e.g. self-concept and mood) was not dependent upon improved physical fitness. Similarly, in their study of the effect of exercise upon the self-concept in children, Hatfield et al. (1985) found that self-concept improved even though physiological indices of body composition and cardiovascular fitness did not change. It is not clear whether improved psychological parameters are based upon improved fitness (and therefore dependent upon the subjects' conscious awareness of this improvement), or whether improved psychological parameters are based upon perceived mastery irrespective of actual fitness gains (Jasnoski et al., 1981; Bandura, 1977; Beck et al., 1979).

Based upon Heaps' assertion that physical improvement enhances psychological function only when an individual is cognitively aware of physical improvement, Abadie constructed a valid and reliable instrument to assess an individual's perception of their physical fitness (1988). In another study furthering this line of research, Abadie found that there is an inverse relationship between perceived physical fitness and actual physical fitness when the influence of actual physical fitness is removed (1988). From this, Abadie concludes that trait anxiety is correlated better with an individual's self-perception of physical fitness than with actual fitness. However, Fox et al.'s results (1985) contradict this. They reported that there was a relationship between increased physical activity levels, improved physical fitness, self-esteem, and physical estimation. According to Fox et al. (1985), physical estimation was the key factor improving self-esteem following increased physical fitness.

E. SONSTROEM AND MORGAN'S MODEL: Suggested Mechanism for Change

What is the relationship between exercise, self-efficacy, and self-esteem? In an attempt to answer this question, Sonstroem and Morgan devised a model and rationale for exercise and self-esteem (1989). Sonstroem and Morgan's model lends structure to an otherwise somewhat confusing body of literature. While there are other theories and hypotheses suggesting mechanisms by which exercise mediates a change in self-esteem through self-concept and self-efficacy, none appear to be as comprehensive or logical. And more importantly, few try to address the question "how and why" exercise can act as an agent of change for self-esteem. This is a recently developed model and as such leaves room for refinements and modification.

In his early review of exercise and self-esteem, Sonstroem (1984) reported that despite an abundance of studies investigating this relationship between 1970 and 1985, advances in explanations for and understanding of the relationship between exercise and self-esteem haven't been forthcoming (Sonstroem, 1984). His rationale for the importance of more focused, theory-oriented studies lies in his perception of the "...pervasiveness of self-esteem in human functioning" (Sonstroem, p. 125, 1984). He argues that "...a rudimentary understanding of these interactions could lead to delivery of more effective services" (p. 125, 1984). In their most recent review, Sonstroem and Morgan (1989) chronicle a model and rationale for the exercise and self-esteem relationship. Their aim is to respond to the problem of "...research in this area (that) has been simplistic in self-esteem theory and measurement and has remained incapable of addressing how or why change may occur (Sonstroem and Morgan, p. 329, 1989).

As the review of the literature suggests, the parameters self-efficacy, self-concept, and self-esteem appear to be inter-related, though independent (Crandall, 1973; Sonstroem and Morgan, 1989; Wylie, 1974). Following an exhaustive review of the literature, Sonstroem and Morgan suggest that there is evidence of an interaction between self-efficacy, self-concept, and self-esteem in the participant's changing attitudes to 'self' following exercise intervention (1989). Their model for the relationship between exercise and self-esteem is based upon Shavelson et al.'s proposed hierarchical model of self-concept.

Sonstroem and Morgan state that "the proposed model focuses on self-esteem enhancement via the generalization of perceived competencies developed at fitness activities" (p. 336, 1989). Accordingly, their model describes a progression from "physical self-efficacy at the base of the figure to global self-esteem at the top of the hierarchy" (p. 332, 1989). Sonstroem and Morgan argue that the "lower level elements are conceived as components of higher level elements, and changes in these lower level elements are postulated as being instrumental to changes in higher order self-conceptions" (p. 332, 1989).

In their model, Sonstroem and Morgan restrict the self-components to those associated with exercise (p. 332, 1989). Hence, in their proposed model, Sonstroem and Morgan argue that an exercise intervention may change an individual's self-perceptions by (going from the specific to the general) improving physical self-efficacy, which may improve physical competence and physical acceptance, and which may in turn improve global self-esteem. Their pilot study supports the logic of this theory (Gemma et al., 1988; Sonstroem and Morgan, 1989). If the participant improves in both physical competence and physical acceptance, Sonstroem and Morgan surmise that the probability of an improvement in global self-esteem is considerably stronger (Sonstroem and Morgan, 1989).

Sonstroem and Morgan (1989) and others (Rosenberg, 1979; Watkins and Park, 1972) indicate that the value an individual places upon components of self-concept is critical in determining what elements of self-concept might predict high self-esteem. As these researchers attest, incorporating a measure of subjective importance for each element included in a self-esteem model would be useful in assessing the nature of self-esteem. However, Sonstroem and Morgan cite research conducted by Hoge and McCarthy (1984) that indicate "that the inclusion of importance has not always enhanced the prediction of esteem" (p. 335). Hoge and McCarthy's study, however, involved youth; teenagers typically are deeply affected by peer pressure, therefore their valuations may not be assessed as important as the valuations of significant others. Older individuals may place more value on what they themselves consider important.

Sonstroem and Morgan (1989) also suggest that factors in the exercise program itself may contribute to improved global self-esteem. Factors such as feedback from the instructor and other participants, mutuality or relationship with

the participants (or social factors), and physical self-awareness may contribute to increased self-esteem following exercise.

Sonstroem and Morgan suggest that a program of 15 to 20 weeks in duration would be "relevant to model variables in terms of the relative stability of broader traits (those higher in the hierarchy) and in terms of the effect of experience on the accuracy of more specific self-perceptions" (p. 333, 1989). Therefore, ideally, program interventions would be approximately 15 to 20 weeks long. Additionally, Sonstroem and Morgan indicate that assessment of variables over a one to two year period "is projected as better able to delineate the manner in which self-esteem may be affected by exercise" (p. 333, 1989).

F. THE EFFECT OF EXERCISE ON LOCUS OF CONTROL

Locus of control may play an important role in improving self-esteem. As stated in the definition of terms, locus of control refers to the degree to which individuals attribute success or failure to internal or external factors. Episodic and/or accumulative antecedents contribute to one's locus of control (Robinson and Shaver, p. 169, 1973). Episodic antecedents refer to relatively isolated and traumatic incidents (such as earthquakes, death of a loved one, etc.) and accumulative antecedents include continuous exposures. There is agreement in the literature that "people are handicapped by external locus of control orientations" (Robinson and Shaver, p. 170, 1973). Extreme shifts to an external locus of control orientation leads to "learned helplessness" (Seligman, 1975). It would appear that any intervention that might enhance internal locus of control could simultaneously improve coping mechanisms for stress and improve self-esteem.

Exercise may be an intervention that can improve internal locus of control. One of the areas in Sonstroem and Morgan's model (of the relationship between exercise and self-esteem, 1989) in which some refinement may be beneficial is in a potential link between locus of control changes leading to self-esteem. Increased perceived internal control may be a mediating factor improving global self-esteem following exercise-induced increased physical competence and acceptance. The literature review has not uncovered studies addressing this specific question, but there are some studies alluding to the relationship between locus of control and self-efficacy along with self-esteem. For example, Litt (1988) makes a case for perceived control and self-efficacy as

cognitive mediators of pain tolerance. He asserts that self-efficacy is separable from locus of control, and that self-efficacy expectations can mediate the "...desirability of providing control" (Litt, p. 149, 1988). Perri and Templer (1985) found that a 14 week exercise program significantly increased self-concept and perceived internal locus of control in older adults. Whether these psychological variables changed concomitantly or as a result in the change in the other is unknown.

Other studies have not found a clear relationship between exercise and locus of control. For example, in their study with pulmonary disease patients, Kaplan et al. (1984) did not find a clear association between an increase in perceived efficacy for walking and an increase in generalized health locus of control measures following a three month walking program. However, perceived efficacy for exercise behaviours similar to walking were found to improve (Kaplan et al., 1984).

Discerning whether a shift in perceived locus of control is a causal determinant of changed self-esteem or an associated effect following an exercise program is difficult. However, Weinhold and Hilferty's (1983) review of self-concept and self-esteem theory and research literature is interesting. They suggest that locus of control is a necessary component for developing and maintaining self-esteem. This hypothesis renders locus of control an important precursor for self-esteem but does not reveal whether locus of control change is associated with, results from, or causes a change in self-concept (via a change in perceived physical competence and/or physical acceptance). In sum, it is not clear that locus of control plays a role in Sonstroem and Morgan's model. It appears that locus of control is an important component of self-esteem, but whether it is a catalyst or mediator in the hierarchy of change exercise may precipitate in self-esteem (as Sonstroem and Morgan's model suggests for other psychological variables) can only be clarified with further research.

G. THE EFFECT OF EXERCISE ON OTHER PSYCHOLOGICAL VARIABLES

As with many psychological variables, ambiguity in terminology can be problematic. More than a few studies of the effects of exercise upon psychological function feature inconclusive results due to this problem. For example, while "an improved sense of well-being" is a common comment

reported following vigorous exercise (Morgan, 1977; Morgan, 1981; Morgan and Goldston, 1987), the terms 'mood' and 'mental well-being' are sometimes used interchangeably as in Moses et al.'s study (1989). Buffone (1984) and Sachs (1984) found that anxiety and depression (referred to as mood states) and self-control can be modified by exercise.

The effect of exercise upon other psychological variables along with physiological variables is generally a beneficial one. For example, Blair et al. (1984) report that teachers participating in a 10 week exercise program exhibited improved fitness, weight loss, lowered blood pressure, and reported higher levels of general well-being along with improved ability to handle job stress. Valliant and Asu (1985) found that older adults involved in a 12 week exercise program significantly reduced depression and reduced body fat concentrations. Tuckman and Hinkle (1986) found that schoolchildren involved in a running program performed better on tests of creativity. In their review of the research exploring the effects of physical conditioning on self attitudes, Ben-Shlomo and Short (1983) concluded that the findings depend upon the subjects' emotional and physical states, training programs, assessment tools, and the subjects' psychological investment in the exercise program. Ben-Shlomo and Short suggest that physical fitness is associated with enhanced self-attitudes in individuals of all ages who have physical and/or emotional disorders (1983).

H. THE RELATIONSHIP BETWEEN EXERCISE AND HOPE:

Exercise as a Coping Strategy for Stress

It is difficult to draw any conclusions about the relationship between exercise and hope due to the dearth of studies on this topic. Therefore, this category of the literature review will not discuss the direct relationship between exercise and hope. Instead, a potential indirect relationship between exercise and hope will be considered. To achieve this, the following topics will be surveyed: components of hope and its role in physical and mental health; coping mechanisms as an element of hope and as an antidote to stress; exercise as a coping strategy for stress; and various hope scales.

Researchers investigating hope agree that hope is an important factor fundamental to good health (Gottschalk, 1985; Obayuwana and Carter, 1982) and critical in an effective coping strategy (Herth, 1989). In their definition and

'dissection' of hope, Obayuwana and Carter conclude (based upon Kubler-Ross and Engel's work) that hope is derived from the following components: ego strength, locus of control (i.e. helplessness or human family support), religion and spiritual awareness (sense of continuity), economic life support system, and education (sum of intuition, enlightenment, lessons of the past) (1982). If physical activity can improve participants' perception of themselves, as Sonstroem and Morgan suggest, and if physical activity can improve participants' perception of control over their lives, then two components of Obayuwana and Carter's suggested five components of hope may strengthen. If self-concept improves and helplessness diminishes following an exercise program, participants may well experience greater hope.

The importance of hope in physical and mental health has been chronicled by a number of investigators in various disciplines. For example, there is clinical and experimental evidence supporting the hypothesis that psychological stress can accelerate or may incite cancer growth due to deleterious effects on the limbic system (Klopfer, 1957; Kowal, 1955; LeShan, 1957 and 1961; Obayuwana and Carter, 1982; Strickland, 1978; West et al., 1952). More specifically, the model suggests that "...impulses set off from the limbic center, or the seat of emotions as it is generally called, trigger hypothalamic activity which may then depress the immune system or induce a pituitary response that in turn elicits noxious endocrine effects," (Obayuwana and Carter, 1982, p. 230). Obayuwana and Carter argue that improved perception of hope may act to enhance the immune and endocrine systems through the limbic system (1982). This model applies to stress-related illness as well; there is ample evidence that stress compromises the immune system. Improved perception of hope may help counter-act the anxiety-, depression-, and stress-related illnesses reported by anyone in a stressful situation. According to a number of investigators, hope not only counteracts the symptoms of stress but functions to reduce anxiety and increase one's ability to cope with stress (Frank, 1975; Obayuwana, 1980; Pelletier, 1977; Simonton et al., 1978 and 1980). As was mentioned earlier, exercise may serve to strengthen hope by improving self-concept and sense of control the participant has over his or her life, and by decreasing anxiety.

Based upon the literature reviewed to date, it appears that many of the studies conducted investigating hope have involved populations with cancer (Gottschalk, 1985; Herth, 1989; Nowotny, 1989; Obayuwana and Carter, 1982).

Gottschalk (1985) based his work on hope and other deterrents to illness upon animal vulnerability studies along with recall of cancer patients' experience. Some work has been done with psychiatric patients, with adults, and with college populations (Erickson and Post, 1983; Miller and Powers, 1988; and Staats, 1989). As Staats states, "...persons with hope seem more likely to initiate activities (e.g. help-seeking) and are more likely to persist in such activities once initiated" (1989, p. 366). Staats' suggested benefit of hope might extend beyond those with compromised physical or psychological systems to the normal population. That is, people with greater hope (in which optimism for the future plays an important role) tend to have beneficial coping strategies for stressful situations. Exercise may be one of these. Additionally, Staats' statement suggests that increased hope may lead to greater exercise adherence (if exercise can be considered one of the "activities" referred to).

Exercise as a stress buffer is not a new concept. The following cites some of the research studies chronicling this relationship. As Sternlicht describes, the typical response to stress is either to avoid the situation (according to Sternlicht, often expressed through terror, dread, fear, anxiety) or to act out against either person(s)/oneself, an object, and/or a situation (Sternlicht, 1980). Exercise is listed among other strategies for reducing stress while maintaining or enhancing self-esteem (Sternlicht, 1980). Thoreson and Eagleston further qualify the experience of chronic stress by citing a characteristic inability to meet demands with inadequate resources, leading to low self-esteem (1983). Thoreson and Eagleston (1983) cite physical exercise as an important stress reducer. Ryan found that among 518 schoolage children, girls named significantly more social support and emotional behaviour as a stress-coping strategy, while boys named physical exercise as a stress-coping strategy (1989). Ryan emphasized that people use different stress-coping strategies at different stages of the coping process. In examining the stress process, Wheeler and Frank isolated a set of 22 variables to determine the relative importance of each as a stress buffer. Using discriminant analysis based on data from nearly 700 males and females, Wheeler and Frank (1988) concluded that there were four "true" stress buffers, including 1) a sense of competence; 2) exercise pattern; 3) a sense of purpose; and 4) leisure activity. Archer found that employing exercise as a preventative approach for stress management among college students resulted in greater situational relaxation and positive self-statements (1986). In their research, Long (1984 and 1985),

Long and Haney (1988 and 1988), and Hinkle (1988) found that increased aerobic conditioning led to decreased anxiety. And in their study of exercise as a buffer against organizational stress, Pavett et al. (1987) found that job stress decreased significantly for the exercise group but increased among controls.

Stress may also be reduced by strengthening hope through improved self-concept and/or sense of control. As Gottschalk reports, stressed mice show an impaired capacity to activate macrophages (1985). Henry has found that animals forced to live in stressful psychosocial environments (in which they had to compete, "...with difficulty or inevitable failure," over a long period of time for food and water) had sustained elevated blood pressure leading to complications such as arteriosclerosis, heart and kidney failure, and cerebrovascular accidents (Henry, 1977). As Achterberg and Simonton report, hope and positive anticipation may counteract stress-related problems through the immune and/or endocrine system. And studies show that exercise can help to control stress and anxiety-related problems such as high blood pressure.

Some researchers suggest physiological explanations behind exercise's effect upon psychological parameters. For example, Morgan (1985) hypothesizes that exercise could improve mood by 1) distracting the individual from his/her 'troubles'; 2) monamine metabolism; or 3) endorphin release. Varrassi et al. (1989) have conducted a study whose results tend to support Morgan's third hypothesis. In their investigation of the effects of physical activity upon maternal plasma beta-endorphin levels and perception of labour pain, Varrassi et al. found that exercise conditioning during pregnancy resulted in reduced pain perception and reduced stress during pregnancy. Additionally, cortisol, or human growth hormone, and prolactin levels were lowered in exercisers while plasma beta-endorphin levels were elevated compared to controls (Varassi et al., 1989). Bandura et al. (1988) contend that perceived self-inefficacy in exercising control over cognitive stressors activates endogenous opioid systems. Employing mathematical operations that could be modified to present either overly taxing cognitive demands or easily controlled functions, (Bandura et al. (1988) tested for the 'biochemistry of stress.' High stress and autonomic arousal were associated with low perceived self-efficacy (highly cognitively demanding). Following performance of the cognitive task, subjects were administered either inert saline or naloxone (the latter is an opiate antagonist tht blocks the analgesic affects of endogenous opiates). Pain level was then measured. According to Bandura et al. (1988), the stress-

induced analgesia found under the saline condition was mediated by the endogenous opioid mechanisms and counteracted by the opiate antagonist. Under these conditions, exercise may act to reduce the stress experience (induced by cognitive stressors and exacerbated by naturally-occurring opioids) by increasing the release of naturally-occurring endorphins.

Investigators with their associated hope scales emphasize different aspects of hope. All agree upon hope's value in physical and mental health. Herth's studies and scale integrate the 'coping mechanism' component (1989) of hope. Some of Herth's theory is derived from Stotland's work in which Stotland postulates that hopefulness is a prerequisite to action and that coping strategies cannot be invoked without this necessary action (Stotland, 1969). More precisely, coping resources may be mobilized without a sense of hope but these coping strategies may be maladaptive and/or unsuccessful (e.g. passivity, withdrawal). As Herth asserts, if circumstances appear threatening to the individual or their goals, their response will depend upon "...the individuals coping resources (secondary appraisal) and level of hope. Both of these factors may be influenced by other intrapersonal (age, sex, race, marital status, religious convictions), environmental (educational level, income, support system, job, family, setting), and illness-related variables" (1989, p. 68).

Miller and Powers (1988) identify 10 elements that are critical in hope (as derived from the literature). These include: mutuality-affiliation, sense of the possible, avoidance of absolutizing, anticipation, achieving goals, psychological well-being and coping, purpose and meaning of life, freedom (the opposite of entrapment which often accompanies hopelessness), reality surveillance - optimism, and mental and physical activation. Conceptualization of Miller's Hope Scale is based upon these items. As such, Millers' Hope Scale measures hope as a complex multidimensional construct, "...which is more than goal attainment, and encompasses a state of being" (Millers and Powers, 1988, p. 9).

The conceptual framework for Nowotny's Hope Scale (1989) lies in antecedents such as stressful stimuli (loss, life-threatening situations, hardships, etc.). As McGee and Clark state, an individual needs some sense of control over their environment and situation in order to maintain hope (1984). From her review of the literature, Nowotny isolates the following concepts as crucial to hope: oriented to the future, active involvement by the individual, related to trust (and originates 'within the individual'), the possibility of

actualization for what is hoped for, relates to or involves others or a Higher Being, and the importance of the outcome of hope to the individual (1989).

As is evident from this brief review of some of the Hope Scales from the literature, coping strategies play an important role in maintaining hope under stressful circumstances. Obayuwana and Carter (1982) emphasize that "...all therapeutic gestures and health plans should include serious, positive attempts to enhance (the) five important indices of the coping apparatus" that, in their opinion, contribute to hope (p. 233, 1982). Some researchers state that physical activity is an important element in hope (Miller and Powers, 1988). It may contribute to hope through a number of factors, including improved self-concept, improved self-esteem, and increased internal locus of control. An improvement in the latter may substantially affect hope by increasing what Herth refers to as action-oriented positive expectancy. However, there are no studies examining the relationship between exercise and hope and therefore, this relationship is unclear.

III. METHODOLOGY

Forty-eight University of Alberta community sedentary, adult, healthy females were recruited as voluntary subjects for this study. Attrition accounted for a 27% decrease in participants in the study; thirty-four (73%) of the subjects completed the study. All but one were non-academic staff members at the University of Alberta and they ranged in age between 23 and 60 years, with a mean age of 41 years.

The pre-intervention and post-intervention tests were conducted over a period of two weeks. The testing sessions were held in the late afternoon and early evening. The earliest test period started at 4:30 p.m. and the latest test period ended at 9:00 p.m. An effort was made to test subjects consistently at the same time of day pre- and post-intervention.

The battery of tests employed was designed to measure four components of physiological function: cardiovascular fitness, muscular strength and endurance, flexibility, and anthropometry. Because the purpose of this study was to follow the theoretical framework outlined by Sonstroem and Morgan (1989) in their rationale and model of exercise and self-esteem, questionnaires designed to measure the psychological variables specified in their model were tested. Other questionnaires were administered to address the subsidiary problem outlined previously. The questionnaires used were designed to measure the following psychological parameters: self-efficacy, physical competence, physical acceptance, self-esteem, locus of control, and hope.

A modified Canadian Standardized Test of Fitness protocol was used to test the participants' physiological function. Prior to the first test period, a Par-Q screening form and a consent form were administered to the participants. The following dimensions of fitness were measured:

Anthropometry

- standing height
- body weight
- girths: chest, waist (abdomen), hip (gluteal), right thigh
- skinfolds: triceps, biceps, subscapular, iliac crest, medial calf, suprailiac, front thigh, and abdominal

Aerobic Fitness

- modified PWC submaximal cycle ergometer test
- pre- and post-test heart rates
- pre- and post-test blood pressure

Muscular Strength and Endurance

- grip strength: right plus left hand
- push-ups (modified)
- sit-ups

Flexibility

- trunk forward flexion (hamstring and lower back flexibility)

Screening and Consent

- Physical Activity Readiness Questionnaire (PAR-Q)
- Adult Consent and Release Form for the CSTF
- medical information (e.g. whether participants were currently taking prescription drugs)

A. SUBJECT SELECTION AND CRITERIA:

Forty-eight women volunteered to participate in an eight week exercise program including pre- and post-program physical fitness tests and questionnaires. The subjects were screened to meet the following criteria:

- 1) Free from illness that would affect their ability to complete the physiological testing or participate in the exercise program. This was assessed with the Par-Q and by telephone interview.
- 2) Sedentary individual, involved in little or no regular, organized physical activity (beyond normal activity necessary for daily life).

The subjects were randomly assigned to two equal groups ($N = 24$). Attrition occurred during the course of the study and fourteen women were deleted from the final analysis. A total of 34 healthy sedentary women were the subjects in the final investigation: eighteen Exercisers (E) and sixteen Controls (C).

B. GROUP DESCRIPTION:**Group 1 - Control (C) N=16**

There were no restrictions placed on the control group regarding energy expenditure except that individual's in the control group were requested to maintain sedentary activity patterns where possible. This group received the fitness program following the exercise group's eight week exercise program.

Group 2 - Exercise (E) N=18

Subjects participated in fitness classes which were conducted three times per week for 60 to 90 minutes.

C. PHYSICAL CONDITIONS OF THE TESTING SITUATION:

Submaximal tests estimating maximal oxygen intake can be affected by temperature variation in the testing situation (Rowell, 1963; Taylor, 1955). All testing was conducted in the same room in this study. The laboratory temperature was controlled, but the relative humidity was not.

D. SJOSTRAND PWC₁₇₀ MODIFIED TEST:

The Sjostrand Physical Work Capacity 170 Test was selected to estimate maximal oxygen uptake and was administered before and after the eight week exercise program. While limited by certain factors such as specificity of training, test familiarity, learning, and pacing, these factors were minimized in this study because the majority of the participants were at the same level of training and test familiarity.

The cycle ergometer test was carried out on a calibrated Monark Ergometer. The same ergometer was used for all tests. A description of calibration procedure can be found in Appendix A.

Heart rate was measured with a Sport-tester. Blood pressure was monitored with a sphygmomanometer and stethoscope.

A description of subject preparation, test procedure, determination of physical work capacity, and prediction of oxygen consumption can be found in Appendix B.

E. ANTHROPOMETRIC MEASURES:

Height and Weight:

Height and weight were measured following the procedure described in the CSTF manual. Height was measured to the nearest millimeter and weight to the nearest gram.

Subcutaneous Fat Measurements:

The Harpenden caliper (Tanner and Whitehouse, 1955) was used to measure the eight skinfolds according to the technique outlined in MacDougall et al. (1982) and Getchell (1983). Measurements were repeated until two of the trials were within 0.5 millimetres of each other and the mean of these two measures was then calculated to represent the value for the site being measured. All measurements were taken on the right side of the body. The procedure followed for skinfold measures can be found in Appendix C.

Girth Measurements:

Eight girth measurements were taken following the procedure described by Brozek (1961b) and Sloan et al. (1962). Even pressure was applied on the girth measure tape without compressing the underlying tissue. The measurements were made while the subject was standing. Procedures for measuring girth measurements can be found in Appendix D.

Computations for Body Composition Values:

Body composition values were computed to estimate the proportion of fat and lean constituents in the Exercise and Control groups at pre- and post-intervention. While the accuracy of the body composition values is compromised by the indirect nature of the assessment, the following equations for predicting body composition render a useful estimate.

Body Mass Index (BMI):

The ratio of body weight divided by height squared (kg/m^2) (Canadian Standardized Test of Fitness Operations Manual; Third Edition, 1986).

Sum of (five) Skinfolds (SOS) in mm:

Sum of triceps, biceps, subscapular, iliac crest, and medial calf skinfolds (CSTF Operations Manual, Third Edition, 1986).

Waist to Hip Ratio (WHR):

The ratio of the waist (abdomen) girth divided by hip (gluteal) girth (CSTF Operations Manual, Third Edition, 1986).

Sum of (two) Trunk Skinfolds (SOTS) in mm:

The sum of subscapular and iliac crest skinfold measures (CSTF Operations Manual, Third Edition, 1986).

F. MUSCULAR STRENGTH AND ENDURANCE:**Sit-Ups:**

Modified sit-ups were performed. Modified sit-ups consisted of curl-ups starting from a flat position (shoulders touching the floor) with knees bent and feet firmly planted on the floor. The subject extended arms in front of them and curled up until the wrists passed the knees. The subject then curled down until the shoulders touched the floor again. Following orientation to the exercise (subjects were asked to try two sit-ups) and a three minute rest, subjects performed sit-ups to exhaustion or until they failed to meet the conditions of the protocol two consecutive times.

Push-Ups:

Modified push-ups were performed. Modified push-ups consisted of push-ups with the knees bent, hands under the shoulders, and the back straight. Subjects were asked to start from a position flat to the floor with elbows bent. One push-up consisted of a full extension of the arms then the lowering of the body until the arms were bent to approximately thirty degrees. The back was to remain straight throughout the test. Following an orientation to the exercise (subjects were asked to try one push-up) and a one minute rest, subjects performed push-ups to exhaustion or until a condition of the test protocol was not met two consecutive times.

Hand Grip:

Measures of hand and forearm strength were taken for both the right and left side. A hand grip dynamometer was used to measure the pressure the subject was able to apply to the dynamometer. Two measures were taken alternately on both the left and right side. The best measure for each was recorded as the hand grip value.

G. FLEXIBILITY:

Flexibility of the hamstrings and lower back was measured with a flexometer. With their shoes off, the subjects placed their feet against the base of the flexometer. One hand was placed over the other such that the fingers of both hands were flush with one another, and the subject leaned forward with arms outstretched in front of them and pushed a metal marker along a scale to their flexibility limit. Legs were maintained in an extended position throughout. Two measures were taken and the best of these was recorded as the final flexibility value.

H. QUESTIONNAIRES ASSESSING PSYCHOLOGICAL PARAMETERS:

The present study tested Sonstroem and Morgan's model (1989) and addressed subsidiary questions of the effect of exercise upon locus of control (and whether there was a relationship between locus of control and Sonstroem and Morgan's theoretical framework) and between exercise and hope. Therefore, tests designed to measure the psychological variables outlined in Sonstroem and Morgan's rationale and model were used, along with a locus of control and hope test. The psychological questionnaires were administered together to the participants in the order in which they are presented below. The questionnaires were administered following the physiological tests.

Perceived Physical Self-Efficacy

The test used to measure physical self-efficacy was modified from Gemma et al.'s (1988) self-efficacy scale and from Ewart et al.'s (1983) and Taylor et al.'s (1985) scale for studies in cardiac rehabilitation. Gemma et al.'s (1988) scale was used within Sonstroem and Morgan's model for examining exercise and self-esteem interactions (this was the pilot study for the model). Ewart et al.'s and Taylor et al.'s cardiac rehabilitation studies have provided validity for self-efficacy scales related to training activities. Activities included in the test include walking, aerobic dance/exercise, stair-climbing, and lifting specified loads (see Appendix E for details). Degrees of physical work in each category increase over eight levels; strength and direction of response is indicated by a ten point scale (from very certain at one to very uncertain

at ten). Gemma et al.'s scale (1988) was scored such that a lower number indicates greater perceived physical self-efficacy and a decrease in score at post-intervention suggests an improvement in perceived physical self-efficacy. The individual scores for the four categories of physical activity (i.e. walking, aerobic dance/exercise, stair-climbing, and lifting) were counted from the overall perceived physical self-efficacy score in order to assess whether perceived physical self-efficacy for specific activities subjects are exposed to generalizes to other physical activity.

Physical Competence

The author was unable to obtain Fox's scale assessing Physical Condition and Physical Strength (the scale suggested by Sonstroem Morgan for measuring physical competence). Instead, another scale discussed by Sonstroem and Morgan measuring perceived athletic ability, Harter's Perceived Competence Scale, was used to assess the subjects' general evaluation of perceived overall physical fitness. This scale outlines two opposite scenarios for physical activity in which the subjects' evaluate their competence within them (see Appendix F for Harter's Perceived Competence Scale). Harter's Perceived Competence Scale was scored such that a higher number indicates greater perceived physical competence and an increase in score suggests an improvement in perceived physical competence.

Physical Acceptance

Secord and Jourard's Body Cathexis Scale (1953) was used to measure the participants' feelings of satisfaction or dissatisfaction with body features and functions. In this scale, thirty-four items are listed (see Appendix G for the Body Cathexis Scale). Strength and direction of response is indicated by a five-point scale (from one: have strong positive feelings to five: have strong negative feelings). The Body Cathexis Scale was scored such that a lower number indicates greater physical acceptance and a decrease in score at post-intervention suggests improved physical acceptance.

Global Self-Esteem

Sonstoem and Morgan (1989) suggest the Rosenberg Self-Esteem Scale (SEI) because it's considered a "content-free scale assessing general self-worth" (p. 335, 1989) and it is rated by others as one of the best scales measuring overall self-regard (Wylie, 1979). Consisting of ten statements, the SEI is scored with a four-point Likert scale (from strongly agree to strongly disagree). Rosenberg's Self-Esteem Scale was scored such that a lower number indicates greater global self-esteem and a decrease in score at post-intervention suggests improved global self-esteem. (See Appendix H for Rosenberg's SEI.)

Locus of Control

James' Locus of Control Scale (1957) (the abbreviated, eleven item version) was used to assess locus of control (see Appendix I for James' Locus of Control Scale). A four-point Likert scale was used to score locus of control (ranging from strongly agree to strongly disagree). James' Locus of Control Scale was scored such that a larger number indicates greater internal locus of control and an increase in score suggests improved internal locus of control.

Hope

Hope was measured with Herth's Hope Scale (HHS) (1989). It correlates well with level of coping (assessed with the Jalowiec Coping Scale). Exercise may play a role in enhancing coping strategies, therefore hope. Herth's Hope Scale was scored such that a lower number indicates greater hope and a decrease in score suggests improved hope. The twenty-nine items comprising Herth's Hope Scale are categorized into three factors: Factor 1 is Action-Oriented Positive Expectancy; Factor 2 is Mutuality of Relationship with Others, and Sense of Personal Competence; and Factor 3 is Temporality of Present Situation with a Future Orientation (see Appendix J for Herth's Hope Scale). These factors were scored and assessed for changes in the Exercise and Control group at post-intervention within hope.

Written, Qualitative Responses

At post-intervention, on the back of the final page of the questionnaires, three questions were posed to assess how the Exercise group felt that the exercise program had contributed to any change they had noticed in both physical and psychological aspects. One-third of a page was allotted for each response. The respondents were asked to give a brief response and the questions were as follows:

- 1) A number of these questionnaires are based on a theory that exercise can improve self-confidence and self-esteem. Do you feel that this was true for you?
- 2) What benefits did you feel the exercise program had for you personally?
- 3) Did you feel any change in your sense of 'control' over your body and/or in your own life attributable to the exercise we did?

In assessing the responses, similar answers were grouped together and frequency of response was measured.

I. EXERCISE PROTOCOL:

Following the pre-intervention testing period, the exercise (E) subjects began the fitness program. A break-down of the components of the program by duration and frequency is presented in Appendix K. Fundamentally, the fitness program consisted of a ten to fifteen minute warm-up period (stretching), fifteen to thirty minute walking period (cardiovascular endurance) on a track, twenty to thirty minute muscular strength, muscular endurance, and flexibility period, and a five to ten minute warm-down (stretching and relaxation). The exercise program ranged from 60 to 90 minutes in duration over the eight week session.

Exercise intensity was increased systematically throughout the program. Changes in cardiovascular intensity were based upon adaptations in participants' self-monitored working heart rates; the duration and pace of walking (and jogging, for those who chose) were both increased over the eight week program to adjust intensity of cardiovascular work. Muscular strength and endurance and flexibility exercises were increased progressively by first increasing the duration of work (i.e. shortening rest breaks) then by increasing intensity. Intensity was increased by increasing the number of movement repetitions. Activity was quantitatively assessed by recording the amount of

time spent involved in warm-up, cardiovascular work, muscular strength and endurance, flexibility, and cool-down for each class (see Appendix K).

J. PROGRAM SCHEDULE:

The post-intervention testing was held the week following the termination of the fitness program. Where possible, subjects were tested at the same hour for both the pre- and post-intervention testing. Like the pre-intervention test, the post-intervention testing was held between 4:30 p.m. and 9:00 p.m.

Two weeks following the post-intervention testing, the Control group received the fitness program. It followed the same protocol as the fitness program for the Exercise group.

K. STATISTICAL ANALYSIS

Group comparability (Control Pre-intervention and Exercise Pre-intervention) was assessed with a repeated measure two-way analysis of variance. The significance of the difference between means obtained from the Exercise and Control groups in physiological fitness and psychological measures was determined with two-way analysis of variance with two between-subject factors (treatment group: control and exercise, and time: pre- and post-) and one within subject factor (the dependent variable under consideration). The independent variables (covariates) were the treatment group (Control and Exercise) and time (pre- and post-intervention). The dependent variables (variates) consisted of the pre-intervention and post-intervention measurements of physiological fitness including:

- cardiovascular function (Sjostrand's PWC₁₇₀ test),
- eight subcutaneous skinfold measures,
- eight girth measures,
- body weight,
- muscular strength and endurance (sit-ups, push-ups, hand grip),
- flexibility;

and psychological parameters including:

- physical self-efficacy,
- physical competence,
- physical acceptance,

- global self-esteem,
- locus of control, and
- hope.

Significance was accepted at the $p < 0.05$ level, where p is the probability that no difference occurred between the independent and dependent variables.

Regression analyses were conducted testing the significance of correlations between pairs of physiological and psychological parameters for the Exercise and Control groups and at pre- and post-intervention. Both pre- and post-intervention measures were regressed to determine whether the exercise intervention was associated with a change in the relationship between parameters. Parameters were rotated to ensure every potential pair for each group and time were correlated. The physiological parameters listed below were chosen if there was a significant change in that parameter in the Exercise group over the intervention period, or if there was a change that was close to reaching statistical significance. The following physiological and psychological parameters were subjected to regression analysis (i.e. a physiological parameter was regressed with a psychological parameter):

- weight,
- tricep skinfold,
- bicep skinfold,
- subscapular skinfold,
- suprailiac crest skinfold,
- front thigh skinfold,
- waist girth,
- thigh girth,
- Body Mass Index,
- Sum Of Skinfolids,
- Waist to Hip Ratio,
- Sum Of Trunk Skinfolids,
- push-ups,
- sit-ups,
- combined grip strength,
- flexibility,
- PWC₁₇₀ absolute,
- PWC₁₇₀ relative, and
- predicted V02 maximum,

- (Questionnaire 1) perceived physical self-efficacy (and its components - walking, aerobic dance/exercise, stair-climbing, and lifting designated weight),
- (Questionnaire 2) perceived physical competence,
- (Questionnaire 3) physical acceptance,
- (Questionnaire 4) global self-esteem,
- (Questionnaire 5) locus of control, and
- (Questionnaire 6) hope and its three constituent factors.

Regression analyses were also conducted pairing psychological parameters. Significance was accepted at the $p < 0.05$ level, where p is the probability that no difference occurred between the independent and dependent variables.

The null hypotheses were as follows: $\mu_{CPre} = \mu_{EPre} = \mu_{CPost} = \mu_{EPost}$
 and: $r_{\rho} = 0$

L. EXPERIMENTAL DESIGN

The experimental design examining the treatment effects on the dependent variables is represented in Table 1.

TABLE 1
EXPERIMENTAL DESIGN

	Pre-Intervention Analysis	8 Week TRTMNT.	Post-Intervention Analysis
GROUP 1 CPre (Control, Pre-Intervention)	59 VARIATES y	pre- intervention	59 VARIATES y
GROUP 2 EPre (Exercise, Pre-Intervention)	y	pre- intervention	y
GROUP 3 CPost (Control, Post-Intervention)	y	no intervention	y
GROUP 4 EPost (Exercise, Post-Intervention)	y	exercise intervention	y

IV. RESULTS AND DISCUSSION

The results and discussion are presented under the following headings and sub-headings:

A. PHYSIOLOGICAL PARAMETERS:

1) Anthropometric Data:

- a) Body Weight;
- b) Skinfold Measurements;
- c) Girth Measurements;
- d) Body Mass Index (BMI in kg/m²);
- e) Sum of (five) Skinfolts (SOS in mm);
- f) Waist to Hip Ratio (WHR in cm);
- g) Sum of (two) Trunk Skinfolts (SOTS in mm);
- h) Body Composition (including body density, per cent body fat, total body fat, and lean body mass);

2) Flexibility

3) Muscular Strength and Endurance (functional tests):

- a) Push-Ups;
- b) Sit-Ups;
- c) Grip Strength (combined right and left hands);

4) Cardiovascular Function during test:

- a) Resting Heart Rate;
- b) Maximum Heart Rate;
- c) Average Heart Rate;
- d) Resting Blood Pressure including Systolic and Diastolic Pressure;
- e) Maximum Blood Pressure including Systolic and Diastolic Pressure;
- f) Average Power Output;
- g) Power Output during final 4 minutes of test;
- h) Predicted V02 Maximum;

B. PSYCHOLOGICAL PARAMETERS:

1) Q1: Perceived Physical Self-Efficacy:

- a) for Walking;

- b) for Aerobic Dance/Exercise;
- c) for Stair-Climbing;
- d) for Lifting Specified Loads;
- 2) **Q2: Perceived Physical Competence;**
- 3) **Q3: Physical Acceptance;**
- 4) **Q4: Global Self-Esteem;**
- 5) **Q5: Locus of Control;**
- 6) **Q6: Hope:**
 - a) Factor 1: Action-Oriented Positive Expectancy;
 - b) Factor 2: Mutuality or Relationship with Others, and Sense of Personal Competency;
 - c) Factor 3: Temporality of Present Situation with Future Orientation.

Group comparability (of subject characteristics, i.e. height, weight, and age) at pre-intervention is presented in Table 2. Based upon the two-way analysis of variance conducted on the Pre-Intervention data, there was a significant difference between the Control and Exercise groups at the pre-intervention assessment in Self-Efficacy. This difference was significant for the aerobic dance/exercise and the stair-climbing component of perceived physical self-efficacy. No significant differences occurred between groups at pre-intervention among the parameters measured. It appears that the two groups came from the same population pool. Specifically, no difference was found between the Exercise group and the Control group at pre-intervention for age, height, weight, skinfold measures, girth measures, muscular strength and endurance scores, flexibility values, cardiovascular measures, and scores for physical competence, physical acceptance, global self-esteem, locus of control, or hope.

TABLE 2
SUBJECT CHARACTERISTICS

		GROUP	
		CONTROL (C)	EXERCISE (E)
HEIGHT (cm)	MEAN	162.5	165.3
	±sd	5.8	5.8
	std. error	1.46	1.34
WEIGHT (kg)	MEAN	68.7	68.5
	±sd	15.0	11.7
	std. error	3.74	2.69
AGE years	MEAN	41.2	41.2
	±sd	10.9	9.2
	std. error	2.72	2.12

A. PHYSIOLOGICAL PARAMETERS

Following the repeated measures two-way ANOVA statistical test, a number of physiological parameter showed statistically significant changes from pre- to post-intervention ($p < 0.05$). These included weight, flexibility, push-ups, sit-ups, combined grip strength, waist girth, thigh girth, tricep skinfold, bicep skinfold, subscapular skinfold, suprailiac skinfold, front thigh skinfold, body mass index, sum of skinfolds, waist to hip ratio, sum of trunk skinfolds, PWC₁₇₀ (absolute), PWC₁₇₀ (relative), and predicted V02 maximum. Of these, an interaction effect (i.e. the difference in scores over time in the Exercise group was not the same as the difference in scores over time in the Control group) was found in measures for push-ups, sit-ups, suprailiac skinfold, and predicted V02 maximum. Specific physiological parameters are dealt with under designated categories following. A discussion and summary follows each category.

1) Anthropometric Data

Statistically significant changes ($p < 0.05$) in anthropometric data were found over time (when scores for both groups were considered together) in measures for weight, waist girth, thigh girth, tricep skinfold, bicep skinfold, subscapular skinfold, suprailiac skinfold, and front thigh skinfold, body mass index (BMI), sum of skinfolds (SOS), waist to hip ratio (WHR), and sum of trunk skinfolds (SOTS). An interaction effect was found in the measures for suprailiac skinfold.

a) Body Weight

Mean pre- and post-intervention values are presented in Table 3. A statistically significant change ($p < 0.05$) in weight occurred between pre- and post-intervention when both groups' scores were considered together. However, no interaction effect was evident. The change in scores over time for the Exercise group was not statistically different than the change over time for the Control group.

The mean weight for the Control group decreased by 0.8 kg over time (a decrease of 1.2%). According to the data gathered for the Canada Fitness Survey, the mean for the Control group falls at the seventieth percentile at both pre- and post-intervention when compared to other women between 40 and 49 years of age (Canadian Standardized Test of Fitness, 1986). The Exercise group mean decreased by 1.1 kg over the intervention period (a decrease of 1.6%). It is interesting to note that the 1.1 kg mean decrease in body weight moved the Exercise group from the seventieth to the sixtieth percentile according to the norms developed for the Canada Fitness Survey.

TABLE 3
EFFECT OF 8 WEEK PROGRAM ON BODY WEIGHT

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
² BODY	MEAN	68.7	67.9	68.5	67.4
WEIGHT	$\pm$ sd	15.0	15.2	11.7	11.7
	std. error	3.73	3.80	2.69	2.69

² significant change over time when both groups' scores were considered together

The mean for both groups was lower at the post-intervention test; together, this change was statistically significant. Because the cardiovascular work done in the exercise program was moderate in nature (consisting of walking) and the program was short in duration (eight weeks), the decrease in mean weight for the Exercise group was not statistically significant compared to the change in the Control group. This finding corresponds with other research. Some investigators have found that a small decrease in mean body weight occurred with a low intensity exercise program (Girandola, 1977) while a program of higher intensity resulted in an increase in mean body weight.

Bjorntorp et al. (1979) have quantified mean body weight loss for an exercise program protocol of three sessions per week of jogging at 0.5 kg per month. This is the average weight loss found for the Exercise group in the present study. However, some research shows no change in mean body weight following exercise periods of short duration (six to ten weeks) (Malsbury, 1980).

The non-significant reduction in body weight exhibited by the Exercise group at post-intervention may be attributed to the moderate intensity of the exercise program, to the fact that there were no diet restrictions imposed upon the Exercise or Control groups, and to the possibility that lean muscle mass was accumulating as fat tissue was being reduced. As Lamb (1984) describes, energy expenditure must be increased or energy intake must be decreased (or

any combination of the two) by approximately 3500 kilocalories to secure a 0.45 kg (one pound) loss of fat tissue. McArdle et al. (1981) and Oscai (1973) report that weight loss that occurs through greater energy expenditure is likely due to greater loss of fat tissue, whereas weight loss that occurs through caloric restriction is more likely attributable to loss of water and lean tissue along with fat tissue. With a mean body weight loss of 1.1 kg, it appears that the Exercise group increased their energy expenditure over energy intake by approximately 7070 kilocalories. The 1.1 kg mean body weight loss may have been due to fat tissue loss resulting from increased energy expenditure (McArdle et al., 1981; Oscai, 1973).

b) Skinfold Measurements

The results for the changes in skinfold measurements are presented in Table 4. The ANOVA revealed a statistically significant change in tricep, bicep, subscapula, suprailiac, and front thigh skinfold measurement over the intervention period when both group scores were combined. An interaction effect was evident in the suprailiac skinfold measure.

TABLE 4

EFFECT OF 8 WEEK PROGRAM ON SKINFOLD MEASUREMENTS

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2 TRICEP (mm)	MEAN	26.8	23.5	26.7	23.1
	$\pm$ sd	8.5	8.9	7.3	6.4
	std. error	2.13	2.23	1.69	1.46
2 BICEP (mm)	MEAN	13.6	11.2	13.3	11.0
	$\pm$ sd	10.4	7.4	8.2	5.6
	std. error	2.60	1.84	1.89	1.29
2 SUBSCAP (mm)	MEAN	21.9	20.8	23.3	20.2
	$\pm$ sd	13.3	13.8	10.5	8.8
	std. error	3.34	3.43	2.42	2.01
ILIAC CREST (mm)	MEAN	19.8	18.0	19.7	19.5
	$\pm$ sd	11.3	10.2	7.8	8.1
	std. error	2.82	2.54	1.78	1.86
2,3 SUPRA- ILIAC (mm)	MEAN	19.0	18.8	20.0	15.9
	$\pm$ sd	10.5	10.2	10.4	7.8
	std. error	2.63	2.56	2.39	1.80
ABD- OMINAL (mm)	MEAN	27.8	26.6	26.0	24.3
	$\pm$ sd	11.9	11.9	8.3	7.5
	std. error	2.99	2.98	1.90	1.71
2 FRONT THIGH (mm)	MEAN	35.9	34.1	35.4	30.4
	$\pm$ sd	10.3	8.0	8.0	7.4
	std. error	2.57	2.00	1.84	1.70
MEDIAL CALF (mm)	MEAN	23.4	23.0	20.1	18.6
	$\pm$ sd	10.4	10.3	7.1	6.4
	std. error	2.59	1.64	2.58	1.47

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group over time when compared to Control group

If subcutaneous fat deposits can be estimated reliably and validly, they can be useful indicators of body fat values because approximately 50 per cent of fat stores are located subcutaneously (Lamb, 1984). Individuals with thicker skinfolds tend to have greater subcutaneous fat and lower body density than those with less thick skinfolds.

Based on the literature, while a decrease in skinfold measurements may be expected in the Exercise group, a decrease in the Control group is not. Again, as with the change in body weight, the change in skinfold measures for the Control group over time may be due to increased seasonal activity.

In the case of the tricep skinfold measurements, research cites mean values at anywhere from 16.08 mm among college age women (Sloan et al., 1962) to 21.2 mm for Ward's study with 36 female subjects. The mean value for tricep skinfolds in the present study is slightly above these measures, perhaps because the present study involves a much wider age range. Because a statistically significant change occurred over time when both groups' scores were combined without an accompanying interaction main effect, it appears that both the Control and Exercise group exhibited a significant change in tricep skinfold measure over time. However, the decrease in tricep skinfold in the Exercise group over time was not statistically significantly different than the decrease in tricep skinfold measure in the Control group over time. The Exercise group mean tricep skinfold measure decreased by 3.6 mm (a 13.5% change), and the Control group's mean score decreased by 3.2 mm (representing an 11.9% change). Like the results observed for weight, this suggests that the change observed in both the Exercise and Control group from pre- to post-intervention for tricep skinfold was similar. This may be due to the increased activity the Control group engaged in with the onset of spring or measurement error.

Some research cites the tricep skinfold measurement as an indicator of obesity (Bray, 1979; Mayer; Stuart et al., 1975). According to these sources, a mean tricep thickness of 25.1 mm for young women indicates the onset of obesity. However, other investigators have found that because the assumption that a constant relationship exists between subcutaneous and inner body fat is misleading, the tricep skinfold measurement is not a good indicator of obesity.

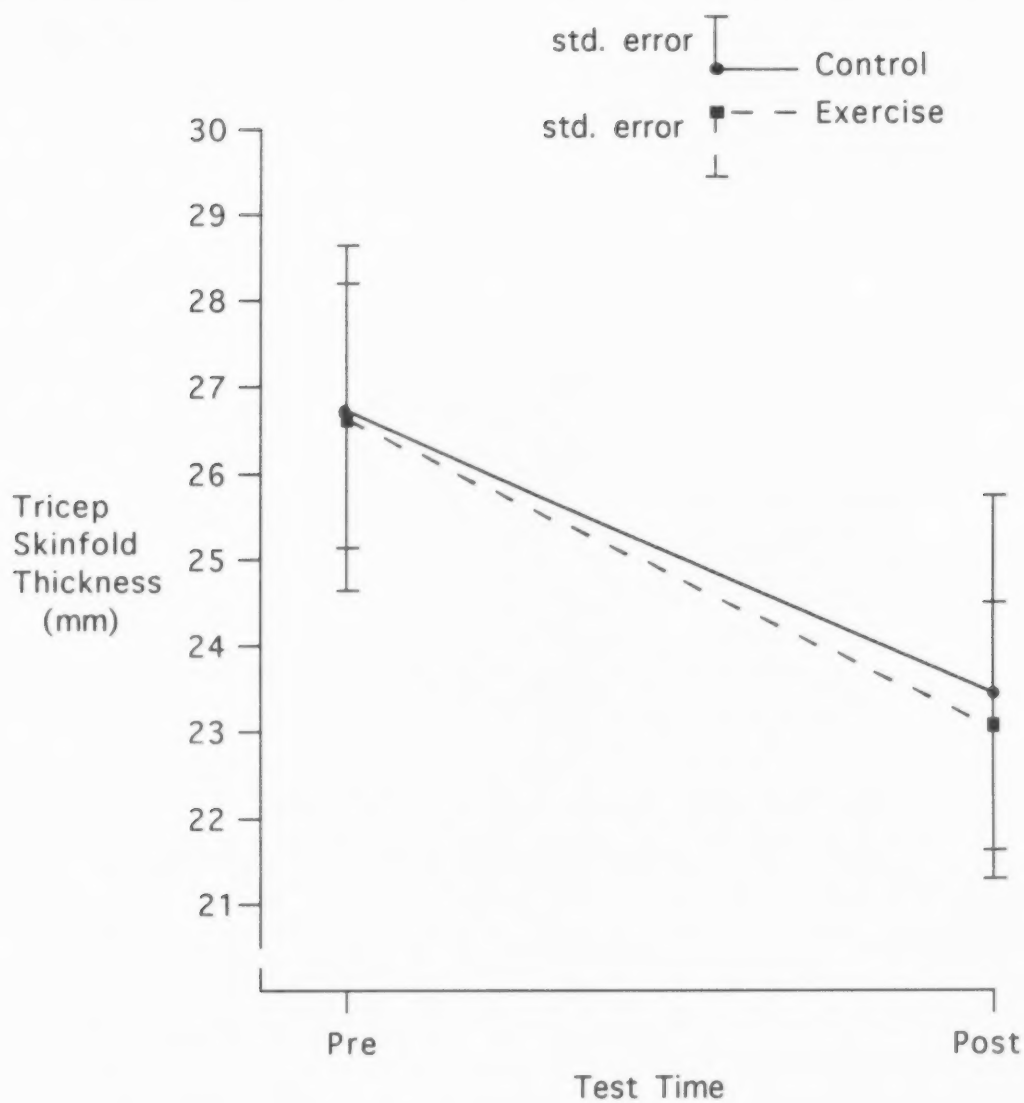


FIGURE 1: Effect of 8 Week Program on Tricep Skinfold Measures

Like the tricep skinfold measurement, the bicep skinfold measurement decreased consistently across time and treatment; both groups' mean skinfold scores decreased over time to a similar degree. A significant difference was observed from pre- to post-intervention when both groups' scores were combined but no interaction main effect was found. The Control group bicep skinfold mean score dropped 17.6% (2.4 mm) and the Exercise group mean measure decreased 17.3% (2.3 mm) from pre- to post-intervention.

Unlike the tricep and bicep skinfold measurements, the decrease in mean subscapular skinfold measurement for the Exercise group following exercise intervention was more than the decrease in the mean subscapular score for the Control group. This change was significant for both groups combined over time, but no interaction main effect was observed. The Control group mean subscapular skinfold measurement decreased 5% while the Exercise group mean value decreased 13.3% from pre- to post-intervention time but this change between treatments was not statistically significant. The large variance exhibited in subscapular skinfold measure scores may have contributed to the non-significant interaction effect.

In their study with 36 female subjects, Ward et al. found a subscapular skinfold mean of 14.1 mm. As with the tricep measures, the reason for the larger mean subscapular skinfold measures in this study is probably due to the wider age range represented in the present study.

The decrease in iliac crest skinfold measurements for both the Exercise and Control group over time was not statistically significant. The Exercise group mean iliac crest skinfold measurement decreased 1% while the Control group measure decreased 8.8% over time. It is interesting to note that the Control group exhibited a greater decrease in iliac crest skinfold measurement. Similarly, Noland and Kearney found that both the exercising group and the control group showed a decrease in iliac crest skinfold scores in their study of the effects of exercise on anthropometric data. However, in Noland and Kearney's study, the exercise group exhibited a greater decrease in mean iliac crest measure.

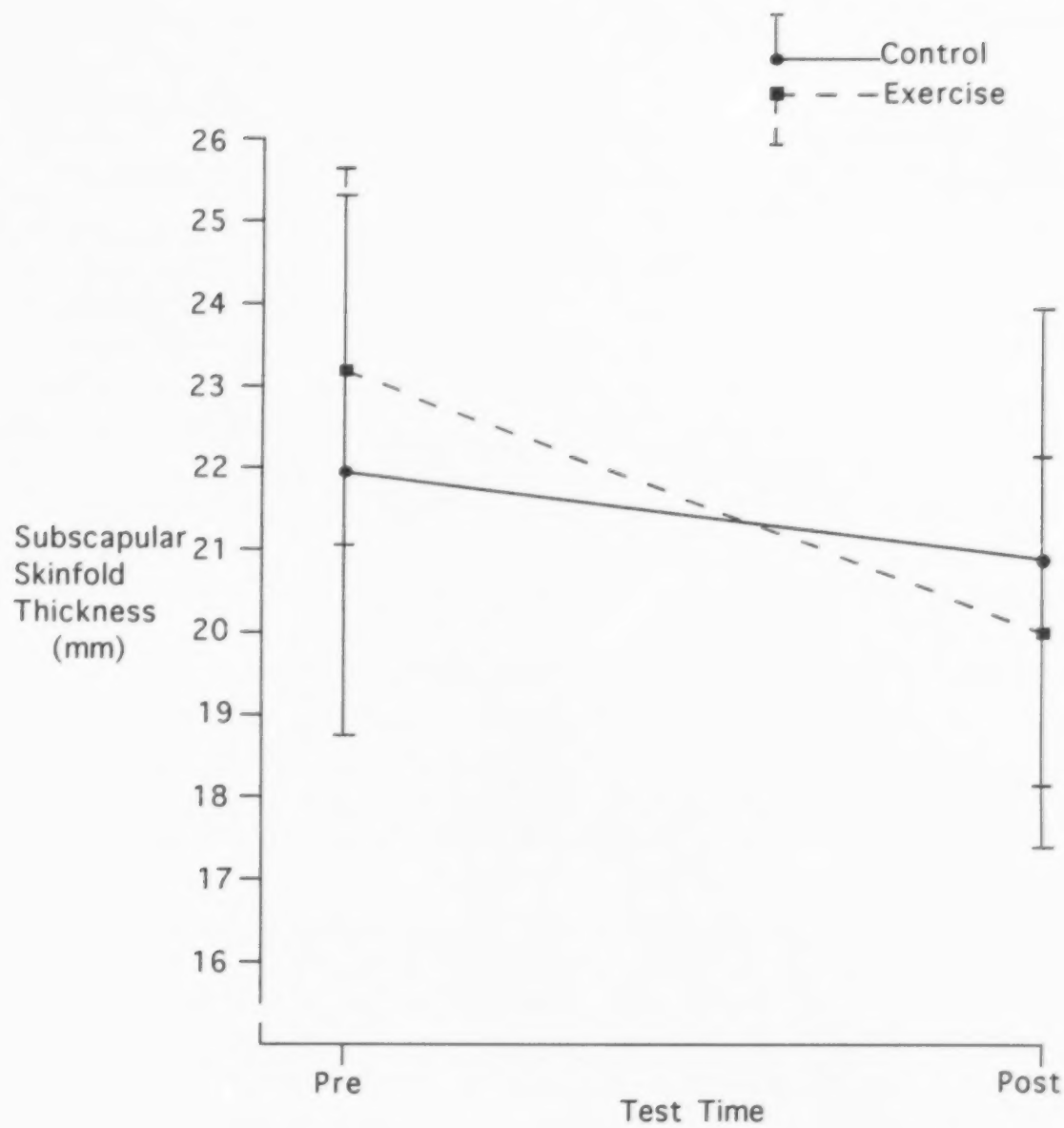


FIGURE 2: The Effect of 8 Week Program on Subscapular Skinfold Measure

The Exercise group mean suprailiac skinfold measurement declined 20.5%; conversely, the Control group exhibited a decrease of 1% in mean suprailiac skinfold. This change was statistically significant over time when the mean scores for both groups were calculated. A statistically significant interaction main effect was also noted. This indicates that the change in the Exercise group over time in mean suprailiac skinfold measure was significantly different than the change in the Control group's mean scores. A significant change in one skinfold measure without a concomitant significant change in other skinfold measures is unusual. As Katch and McArdle (1983) state, changes in skinfold thickness as a result of exercise participation is usually consistent throughout the body. It is generally conceded that "spot reducing" is a myth (Lamb, 1984). While a reduction in subcutaneous fat has been noted in the Exercise group in all skinfold measures taken, only the Exercise group's suprailiac mean measure has been significantly different than that of the Control group over time. Three explanations for this observation are offered: concomitant change in the Control group's skinfold scores (due, possibly, to their increased activity level during spring and early summer) over time compounded the difficulty in reaching statistical significance; a large enough change in suprailiac mean score over time offset the wide variance observed throughout the present study, resulting in a statistically significant interaction effect; or measurement error contributed to the unusually large decrease in the Exercise group's mean suprailiac score.

The changes in abdominal skinfold measurements were not statistically significant for either group. The decline in abdominal scores for both the Control and Exercise groups were very similar (4.3% and 6.5%, respectively). Conversely, Noland and Kearney found a mean increase of 1.6 mm in the exercise group's umbilicus measure in their comparison of exercise and control groups and the effects of exercise on anthropometry in women. According to Jokl (1964), the abdominal skinfold measure, more so than other skinfold sites, may represent excess subcutaneous fat deposits.

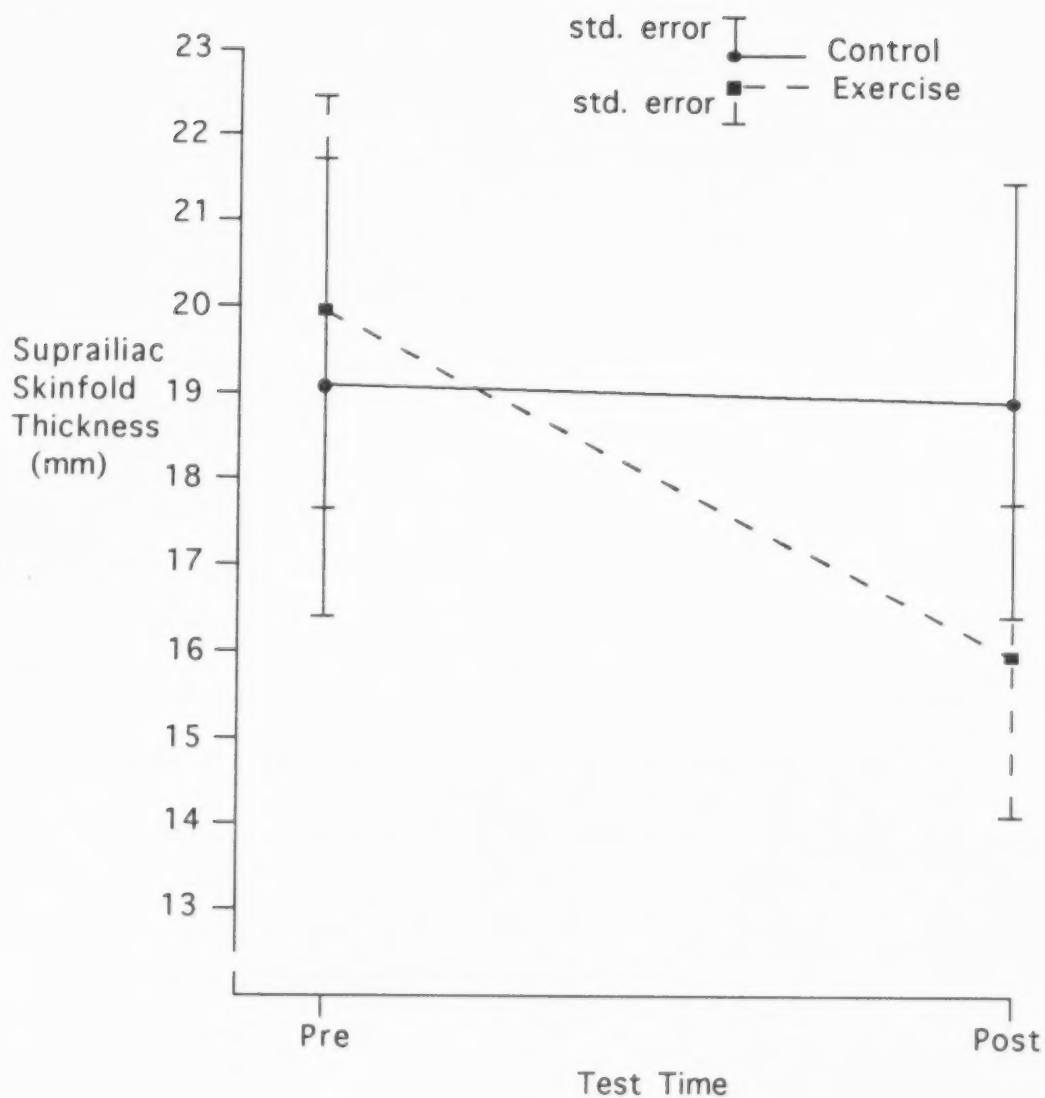


FIGURE 3: Effect of 8 Week Program on Suprailiac Skinfold Measurements

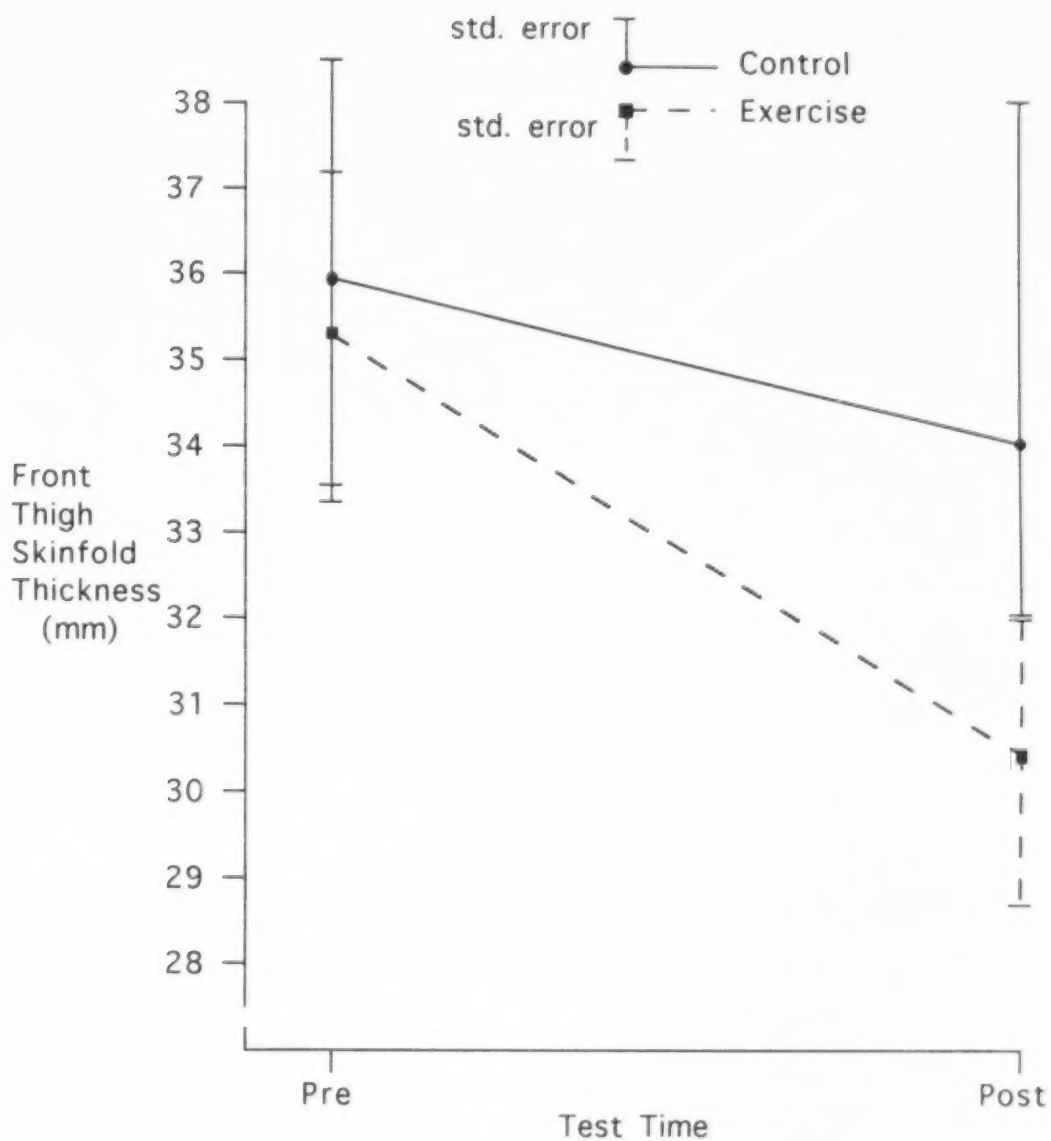


FIGURE 4: The Effect of an 8 Week Exercise Program on Front Thigh Skinfold Measure

The decrease in front thigh skinfold measurements over time when both groups' scores were considered was statistically significant. However, the interaction main effect was not. The Exercise group mean front thigh measurement decreased 14% and the Control group mean value decreased 5% over time. As with other skinfold measures, the Exercise group mean score decrease was notably larger than that of the Control group; large variance in scores (a product of the wide age range) made it more difficult to achieve statistical significance.

The changes in medial calf scores did not exhibit statistical significance. The Exercise Group mean medial calf skinfold measurement decreased by 7.5% while the Control group mean measurement dropped by 1.7%.

Results from the skinfold measurements indicate that only the Exercise group's mean suprailiac skinfold measure was significantly different than the Control group's suprailiac score over time. The short duration (eight weeks) and moderate intensity of the exercise program in the present study along with the wide variance in scores may have contributed to the non-significant changes in other skinfold measures exhibited by the Exercise group over time. Other researchers report similar results. Girandola (1977) and Malsbury (1980) attribute no significant change in skinfold measurements to the short duration of the exercise programs involved in their studies.

It is interesting to note that while only one of the skinfold measurement changes in the Exercise group were significantly different than the Control group's changes over time, some changes were large. For example, the subscapular skinfold mean value decreased by 13.3% in the Exercise group versus a 5% decrease in the Control group; the Exercise group's iliac crest skinfold score decreased by 8.8% versus a 1% decrease in the Control group's mean score; a 14% decrease in front thigh mean skinfold score was observed in the Exercise group versus a 5% decrease in that of the Control group; and a 7.5% decrease in medial calf mean skinfold score was noted in the Exercise group versus a 1.7% decrease in the Control group's mean score. Because of the large age range, the variance in skinfold measures was great and the degree of change following exercise intervention was probably inconsistent. For example, the Exercise group's mean post-intervention subscapular value was 20.2, the standard deviation was 8.8, and the standard error was 2.0. This suggests a great deal of variance in the scores, which could be attributable to the large age range. Measurement error could also be the cause.

c) Girth Measurements

Table 5 presents the changes in girth measurements for all eight sites. Statistical significance over time ($p < 0.05$) with both group's scores combined was found for changes in waist and thigh girth measurements but no interaction main effects were observed.

TABLE 5
EFFECT OF 8 WEEK PROGRAM ON GIRTH MEASUREMENT
GROUP

		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2 WAIST (cm)	MEAN	81.7	81.2	79.9	77.2
	$\pm$ sd	14.7	15.8	10.7	9.2
	std. error	3.67	3.94	2.48	2.12
HIPS (cm)	MEAN	103.7	104.8	100.1	99.6
	$\pm$ sd	15.8	14.5	10.7	9.5
	std. error	3.96	3.63	2.45	2.19
CHEST (cm)	MEAN	97.5	96.3	97.2	96.1
	$\pm$ sd	12.4	11.3	9.3	9.3
	std. error	3.10	2.83	2.14	2.12
CALF (cm)	MEAN	36.6	36.6	36.0	36.4
	$\pm$ sd	2.9	2.8	2.9	3.0
	std. error	0.73	0.70	0.67	0.70
BICEP (cm)	MEAN	29.7	30.1	30.3	30.1
	$\pm$ sd	4.1	4.1	3.7	3.7
	std. error	1.01	1.01	0.84	0.85
ELBOW (cm)	MEAN	24.6	24.7	24.8	24.8
	$\pm$ sd	2.5	2.4	1.9	2.1
	std. error	0.62	0.59	0.43	0.49
KNEE (cm)	MEAN	37.6	37.9	37.9	37.6
	$\pm$ sd	3.1	3.3	2.4	2.6
	std. error	0.78	0.83	0.55	0.59
2 THIGH (cm)	MEAN	51.6	52.8	51.1	52.1
	$\pm$ sd	5.8	6.6	4.6	5.6
	std. error	1.45	1.65	1.07	1.29

AVERAGE	MEAN	58.3	58.1	58.5	56.7
(cm)	$\pm$sd	7.0	7.2	8.3	4.8
	std. error	1.75	1.79	1.89	1.09

2 significant change over time when both groups' scores were considered together

The changes over time in mean waist girth size for the Exercise and Control groups combined were statistically significant. However, the difference between the pre- and post-intervention scores over time was not significant.

Mean values for waist girth among college age women range between 60.6 cm and 76.76 cm (Sloan et al., 1962; Ward et al., 1975; Young et al., 1961). The mean waist girth values in the present study are slightly higher than this, perhaps due to the wider diversity in age range.

Hip girth did not change significantly over time or between treatments. Research with college-age women show that mean hip circumference for this age group falls between 84.9 cm and 97.63 cm (Sloan et al., 1962; Ward et al., 1975; Young et al., 1961). Again, the difference between the mean hip girth values reported in other research and mean hip girths recorded in this study may be due to the wider age range of the subjects in the present study.

The change in chest girth did not demonstrate statistical significance for either group over time.

Neither the Exercise group nor the Control group exhibited statistically significant changes in calf girth. Mean calf measurements reported in other research range between 35.5 cm and 36.6 cm (Ward et al., 1975; Young et al., 1961). The mean values for calf girths for both groups in the present study correspond to these findings.

The change in mean bicep girth in the Exercise group over time was not significantly different than the change in the Control over time. Bicep girth in both groups stayed the same over time. Other studies report mean bicep girth measures for women within the range of 27 cm (Katch and McCardle, 1983; Ward et al., 1975; Young et al., 1961). The mean bicep girth for both the Control and Exercise groups are slightly larger than the mean values for bicep sites reported in the literature.

Mean elbow girth values for both the Exercise and Control groups did not change significantly post-intervention.

Like the mean elbow girth values, the mean knee girth measurements did not change statistically significantly.

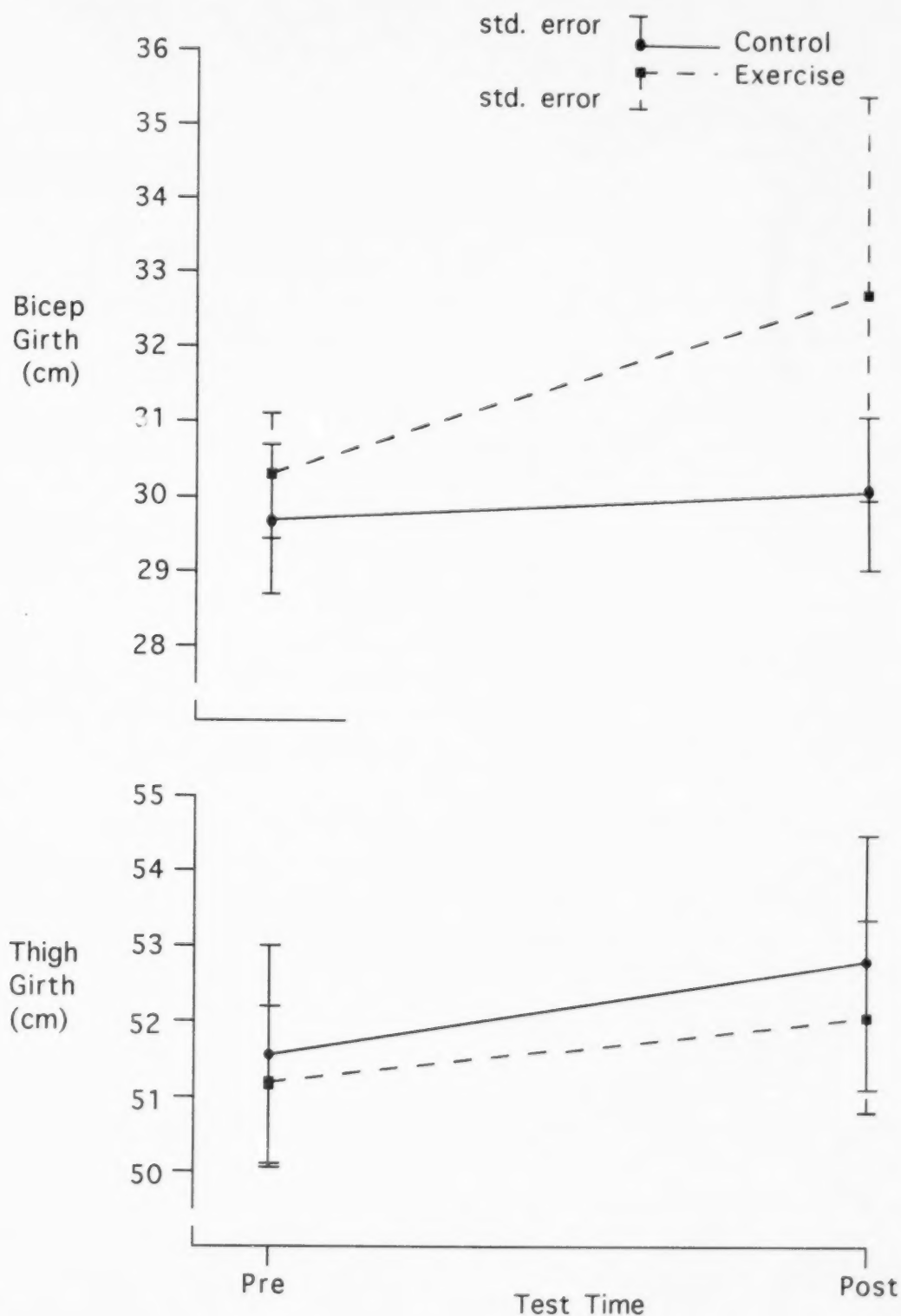


FIGURE 5: The Effect of an 8 Week Exercise Program on Bicep and Thigh Girth

While there was a statistically significant change over time in thigh girth measure when both the Control and Exercise group scores were considered, no interaction main effect was observed. As the statistical analysis suggests, both the Exercise and Control groups exhibited a similar increase in mean thigh girth measure. Mean thigh circumference values reported in the literature include Katch and McArdle's cited mean thigh girth of 55.5 cm for women between 17 and 26 years; Sloan et al.'s described mean thigh measures of 54.33 cm; and Young et al.'s reported mean thigh circumference for college women of 57.59 cm. The mean thigh girth values found in the present study are lower than these values.

To gauge overall change in mean girth measure for the Exercise and Control groups following exercise intervention, an average for the eight girth measures for each subject was calculated. An ANOVA revealed no statistically significant differences between the mean girth averages for either group over time. This result suggests that there was no significant change in girth measure overall for either the Exercise or Control group.

As with the skinfold measurements, the intensity and duration of the exercise program may not have been sufficient to cause a change in girth measurements in the Exercise group.

d) Body Mass Index (BMI):

Mean pre- and post-intervention values for Body Mass Index (BMI), Sum of Skinfolts (SOS), Waist to Hip Ratio (WHR), and Sum of Trunk Skinfolts (SOTS) are presented in Table 6.

TABLE 6
EFFECT OF 8 WEEK PROGRAM ON BMI, SOS, WHR, AND SOTS

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2 BMI	MEAN	26.13	25.81	25.02	24.60
	$\pm$sd	6.1	6.1	3.6	3.6
	std. error	1.53	1.53	0.82	0.82
2 SOS	MEAN	105.42	96.49	103.08	92.36
	$\pm$sd	49.8	46.7	33.6	30.3
	std. error	12.44	11.68	7.71	6.95
2 WHR	MEAN	0.786	0.771	0.796	0.774
	$\pm$sd	0.05	0.07	0.04	0.05
	std. error	0.012	0.017	0.008	0.013
2 SOTS	MEAN	41.7	38.8	42.9	39.6
	$\pm$sd	23.5	22.8	17.6	16.3
	std. error	5.89	5.70	4.04	3.74

2 significant change over time when both groups' scores were considered together

The Body Mass Index is a ratio of body weight to the height squared. This value allows the comparison of body mass to the body frame height, hence rendering a value that is more representative of the subjects' proportions.

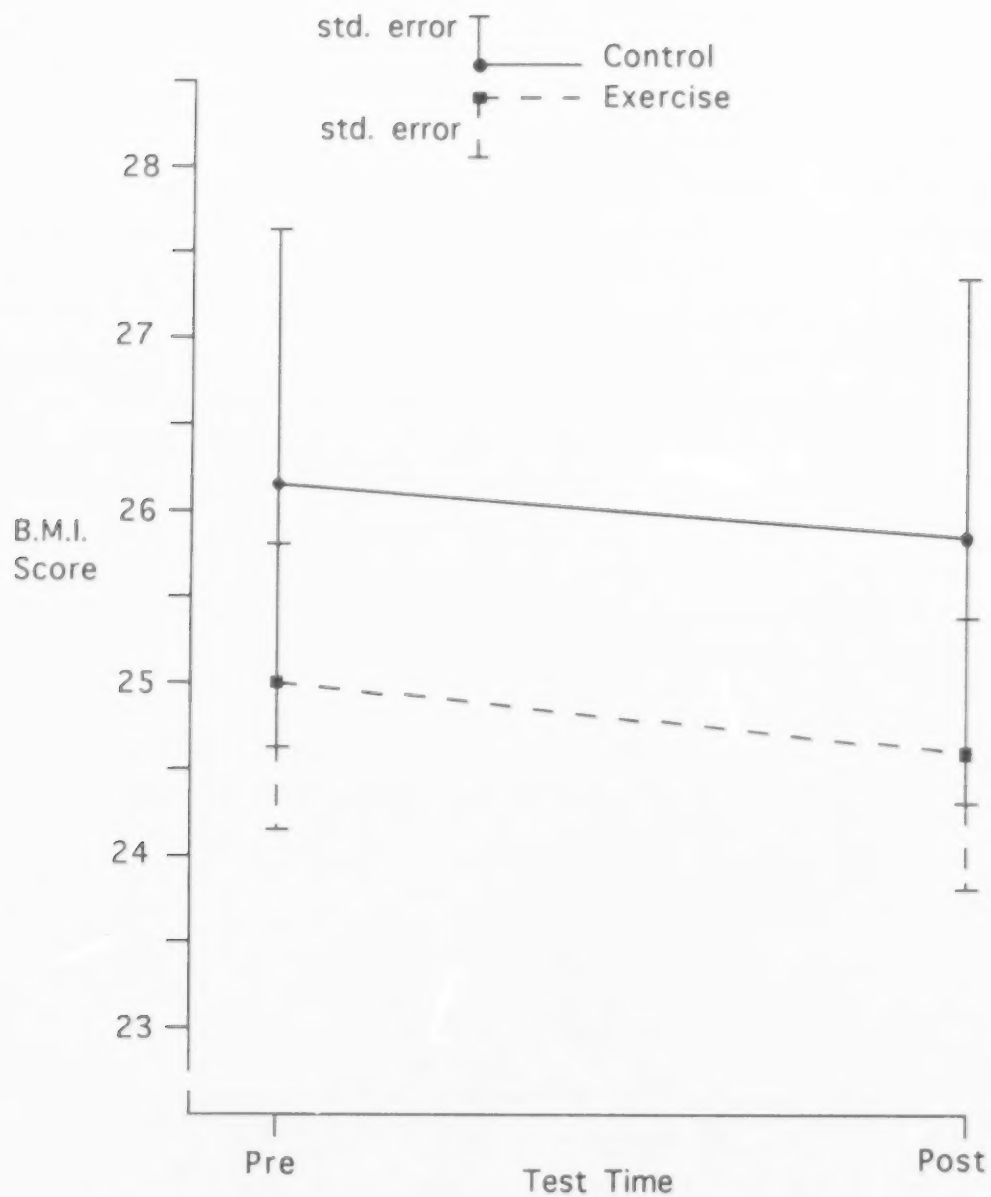


FIGURE 6: The Effect of an 8 Week Exercise Program on Body Mass Index (BMI)

Combined measures for BMI for the Exercise and Control group did show a statistically significant decrease over time; however, the Exercise group's mean BMI change over time was not significantly different than that of the Control group over time. As with the anthropometric measures, significant changes in body composition scores occur more readily with longer, more intense exercise programs. However, what the repeated measures ANOVA suggests is that there was a significant change in BMI in both the Control group and Exercise group when they were considered together for analysis. This unanticipated change may be due to the increased activity the Control group engaged in as a result of the annual seasonal changes in activity (as has been mentioned previously).

The mean Body Mass Index for both groups (both pre- and post-intervention) fall within the thirtieth and fortieth percentile for the 40 to 49 year age group (based on 1981 Canada Fitness Survey data). The Exercise group's post-intervention BMI improved enough that the mean measure was better than forty to forty-five percent of the BMI measures for female 40 to 49 year olds. The Control group mean BMI improved from a score that was better than thirty percent of the 40 to 49 year old Fitness Survey participants to a post-intervention BMI that was better than the BMI scores of between thirty and thirty-five percent of the 40 to 49 year old Fitness Survey participants.

e) Sum of (five) Skinfolds (SOS):

The Sum of (five) Skinfolds or SOS gives an indication of obesity. It is a better overall indicator of the subjects' subcutaneous skinfold status than individual skinfold measures alone. The SOS is a sum of the following five skinfolds: triceps, biceps, subscapular, iliac crest, and medial calf.

Like the BMI, the decrease in the mean SOS score was significantly different over time when both the Control and Exercise group mean scores were considered together. No interaction main effect was observed, however. As with the BMI and some of the anthropometric measures, the repeated measures ANOVA results suggest that a change in both the Control and Exercise groups' mean SOS occurred. This is reinforced by the data; the Control group exhibited an 8.4% decrease in mean SOS (8.9 mm change) and the Exercise group exhibited a 10.4% decrease in mean SOS (a 10.7 mm change). Increased activity levels in the Control group over the intervention period may have caused the unexpected change in that group.

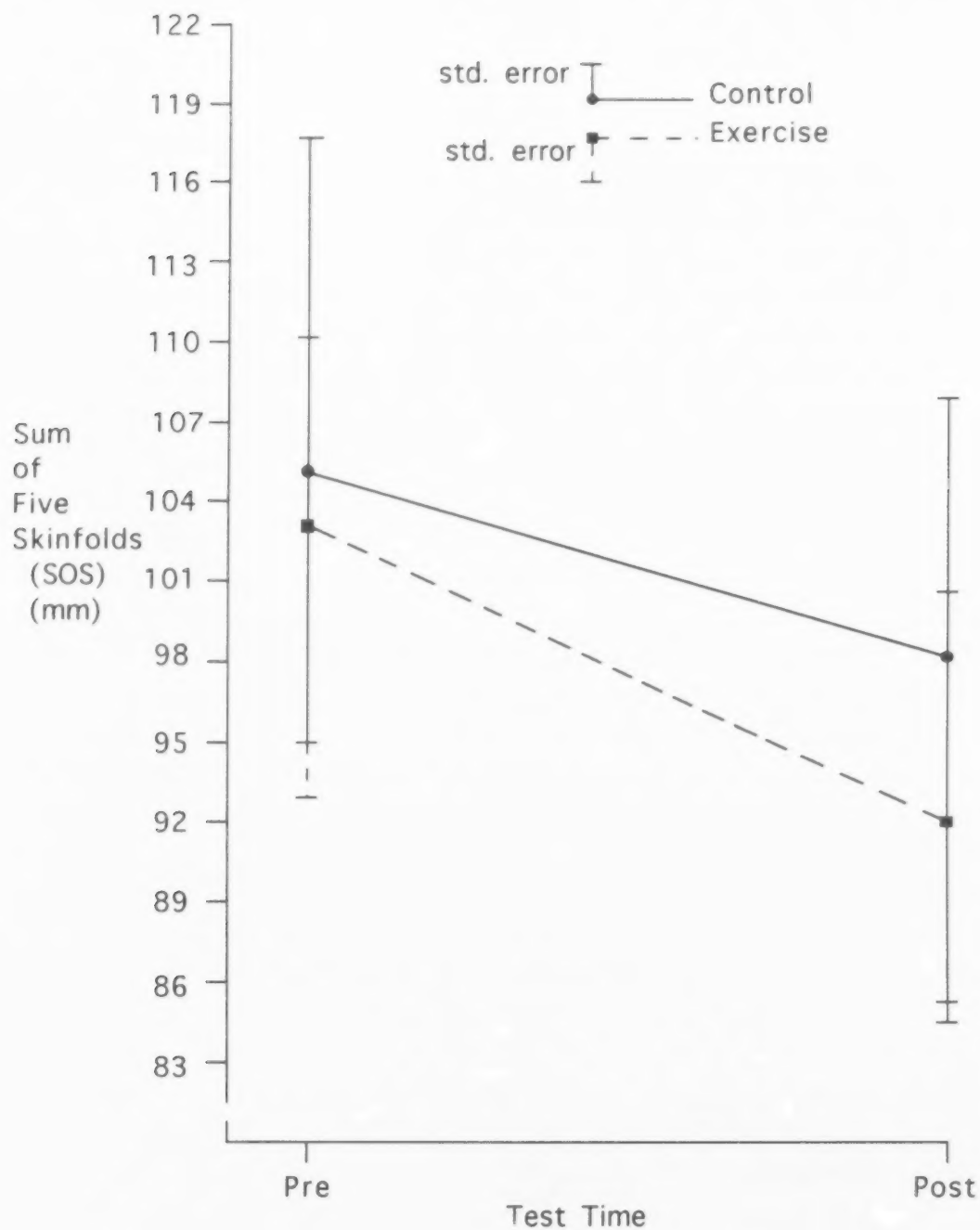


FIGURE 7: The Effect of an 8 Week Exercise Program on the Sum of (five) Skinfolds (SOS)

The Control group mean SOS improved from a pre-intervention percentile of twenty to a post-intervention percentile of approximately twenty-seven. The Exercise group's mean SOS improved from a pre-intervention sum that was better than about twenty percent of the 40 to 49 year old females assessed for the Canada Fitness Survey (1981) to a post-intervention score that was better than about thirty-three percent of the 40 to 49 year old female Canada Fitness Survey participants (1981). All of the Sum of Skinfold (SOS) values (Exercise and Control, pre- and post-intervention) were within the estimated health risk zones according to trends in morbidity and mortality data (Canadian Standardized Test of Fitness Operations Manual, Third Edition, 1986).

f) Waist to Hip Ratio (WHR):

The waist to hip ratio gives some indication of proportionality in the trunk region. The closer to unity the waist to hip ratio is, the more similar in size the waist and hip. As with BMI and SOS, the mean WHR showed a significant decrease when both the Exercise and Control group's mean scores were considered. There was no significant difference between the decrease in the Exercise group's mean WHR score over time and the decrease in the Control group's mean WHR score over time. The Control group's waist to hip ratio decreased by 1.9%. Similarly, the Exercise group's waist to hip ratio decreased by 2.8%. As the statistical analysis suggests, the change in both the Control and Exercise group mean Waist to Hip Ratio was similar. Again, this may be due to the increased amount of activity the Control group engaged in over the intervention period.

When compared to waist to hip ratios calculated for 40 to 49 year old females (from Canada Fitness Survey Data gathered in 1981), the Control group's mean pre-intervention ratio improved from a value that fell approximately within the forty-second percentile to a mean ratio at post-intervention that fell within the fiftieth percentile. The Exercise group's mean waist to hip ratio was better than about thirty-two percent of the 40 to 49 year old female subjects of the Canada Fitness Survey (1981 data) pre-intervention. Their ratio improved at post-intervention to the 48th percentile when referenced to the Fitness Survey.

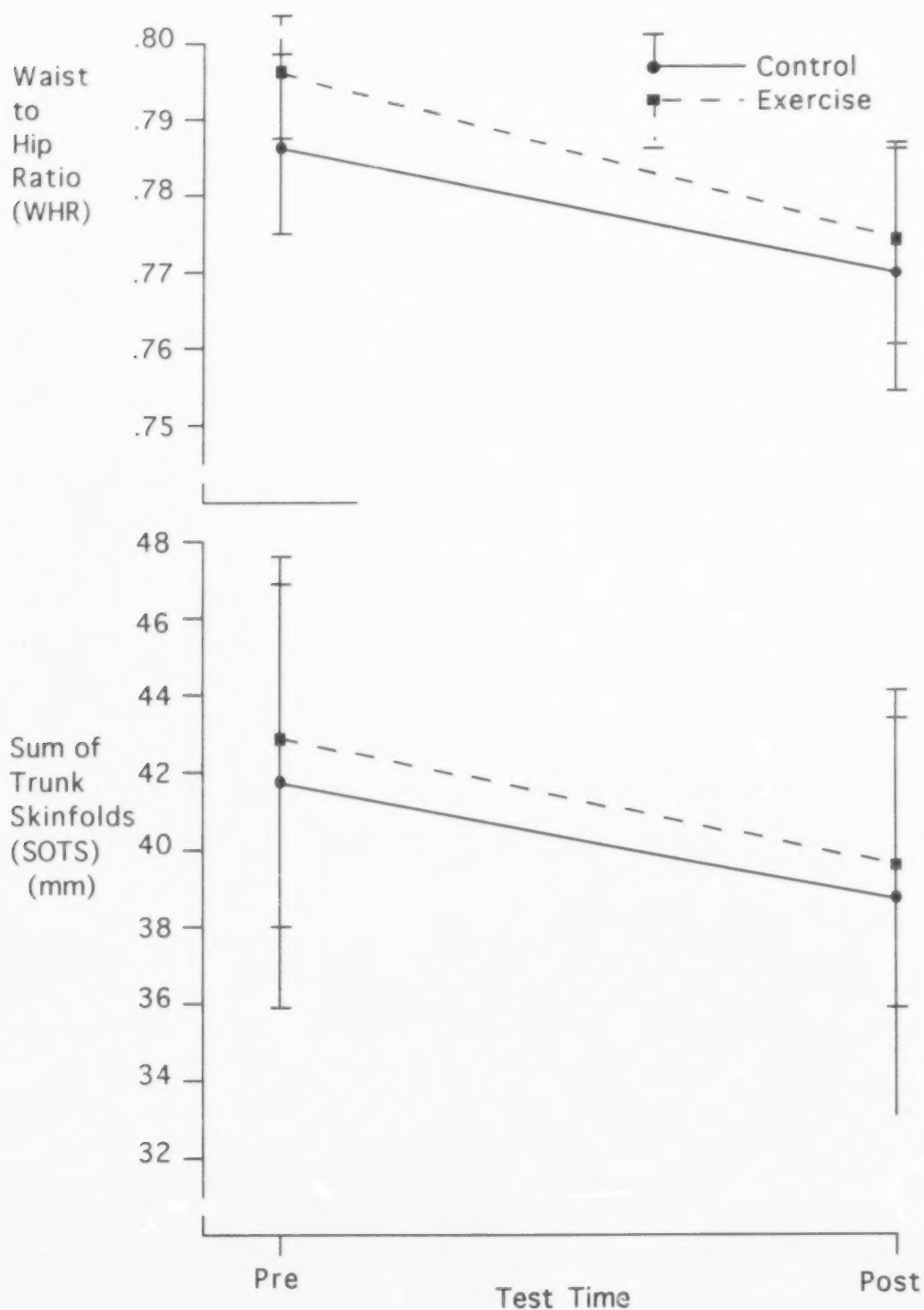


FIGURE 8: The Effect of an 8 Week Exercise Program on Waist to Hip Ratio (WHR) and Sum of Trunk Skinfold Measures (SOTS)

g) Sum of (two) Trunk Skinfolds (SOTS):

The Sum of Trunk Skinfolds (SOTS) gives an indication of trunk region obesity. SOTS is the sum of the subscapular and iliac crest skinfold. A similar decrease in SOTS was suggested for both the Control and Exercise group; the combined scores for both groups rendered a significant change in mean SOTS over time but the Exercise group's mean SOTS did not decrease significantly differently than the Control group's mean SOTS over time. The Control group mean pre-intervention value dropped 6.9% and the Exercise group mean SOTS measure decreased by 7.7%. Increased activity in the Control group over the intervention period may account for this unexpected change in Control group mean SOTS exhibited.

According to trends in morbidity and mortality data, mean SOTS for both the Exercise and Control group's pre- and post-intervention fall within estimated health risk zones (Canadian Standardized Test of Fitness Operations Manual, Third Edition, 1986). More specifically, the Control group mean pre-intervention SOTS falls within approximately the twenty-eighth percentile. Their mean SOTS improved post-intervention to approximately the thirty-second percentile. The Exercise group's mean pre-intervention SOTS improved from the twenty-fifth percentile to approximately the thirty-first percentile at post-intervention. For both groups, the mean trunk skinfold sums were well above the average found among the participants of the Canada Fitness Survey (1981) for women between 40 and 49 years of age.

DISCUSSION and SUMMARY for Anthropometric Data and Body Composition

Statistical significance was often observed for the Repeated Measure (B) analysis (examining the change in the Control and Exercise groups' mean measures together over time) for anthropometric data. That is, when both the Exercise and Control group's mean scores were considered together, significant changes were found for weight, tricep skinfolds, bicep skinfolds, subscapular skinfolds, front thigh skinfolds, waist girth, thigh girth, BMI, SOS, WHR, and SOTS at post-intervention. However, an interaction main effect was observed in only the suprailiac skinfold parameter. The anthropometric and body composition data suggest that while there was a significant change for both groups in the parameters listed over time, among the Exercise group's

mean scores, only the suprailiac skinfold measure changed significantly differently than the mean suprailiac skinfold score in the Control group over time. The observations from the two-way repeated measures ANOVA indicate that while the Exercise group's improvements in body composition were not significantly different than body composition improvements in the Control group, both groups exhibited significant improvement in body composition at post-intervention. That is, both the direction and degree of change in many anthropometric measures and body composition scores were similar for both the Exercise and Control groups. As was previously mentioned, three explanations may account for this. Firstly, the short duration and moderate intensity of the exercise program may have curtailed improvements in the Exercise group in anthropometry and body composition. Secondly, the Control group may have engaged in increased informal physical activity during the intervention period (confirmed for some of the participants by informal comments), increasing the degree of change in anthropometric data and body composition for Controls. Thirdly, measurement error may account for some of the changes (or lack thereof) observed. The research supports the first explanation; Girandola (1977) and Malsbury (1980) reported that there was no significant improvement in anthropometric data in the exercise group following exercise intervention of six and eight weeks, respectively.

In the present study, the wide age range of the participants may have contributed to non-significance of the anthropometric and body composition results. The standard deviation and standard error exhibited for the anthropometric data are quite high due to the variance in scores. As the data in the Canada Fitness Survey show, mean anthropometric values change considerably with different age groups; this may have been reflected in the diversity of scores.

There is some indication that the Exercise group exhibited a greater increase in lean body mass and decrease in body fat than the Control group according to values for body density, per cent body fat, total body fat, and lean body mass (see Appendix L for results, table, and graph for body density, per cent body fat, total body fat, and lean body mass). The Exercise group's body density value and lean body mass measure exhibited over twice the increase at post-intervention than the Control group (body density: 0.3% increase in the Control group and 0.8% increase in the Exercise group; lean body mass: 1% increase in the Control group versus 3.9% increase in the Exercise group). The

decrease in body fat was more pronounced in the Exercise group than the increase in body density. More specifically, the Exercise group's per cent body fat decreased by 12% while the Control group's per cent body fat decreased by 5%. The Exercise group's total body fat decreased 13.4% while the Control group's total body fat decreased by 6%. The increase in muscle mass and decrease in body fat in both groups may have resulted in the significant change in body weight observed for the Exercise and Control groups together at post-intervention. However, the results for body fat and lean body mass were not subjected to statistical analysis and therefore can only be suggested.

To summarize, mean weight decreased significantly when both groups were considered together. It appears that there was a significant decrease in mean skinfold measurements for both groups together in all but three measures (iliac crest, abdominal, and medial calf). The Exercise group's mean suprailiac skinfold measure was significantly different than that of the Control group over time. Of the girth measurements, only waist and thigh girth mean measures decreased significantly when both groups' scores were considered together. Mean scores for Body Mass Index, Sum of Skinfolts, Waist to Hip Ratio, and Sum of Trunk Skinfolts were significantly different over time when both Exercise and Control group measures were considered together. Lean body mass and body fat totals suggest similar directional changes for both the Exercise and Control groups, but a greater degree of improvement in the Exercise group's body composition is indicated. These results considered together suggest that both the Exercise and Control group exhibited an improvement in body composition and anthropometric data. The degree of improvement in the Exercise group was statistically significantly different than that of the Control group in only the mean suprailiac skinfold measure. However, where no significantly different improvements in the Exercise group versus the Control group over time were found, the degree of change in the Exercise group was often greater than that of the Control group (i.e. the Exercise group's subscapular skinfold decreased 13.3% while the Control group's decreased 5%; the Exercise group's front thigh skinfold decreased 14% while the Control group's decreased 5%; the Exercise group's iliac crest skinfold decreased 8.8% while the Control group's decreased 1%). The large variance in scores (possibly resulting from the wide age range and low number of subjects) may have rendered it more difficult to reach statistical significance.

2) Flexibility Measurement

Mean pre- and post-intervention flexibility measures are presented in Table 8. The trunk forward flexion test is designed to measure flexibility in the lower back and the hamstring muscle groups. The ANOVA revealed a significant change in flexibility over time when the Exercise and Control group scores were considered together. However, no difference between the groups was observed over time. Even though the changes were not significant, the mean difference pre- to post-intervention for the Exercise group (15.4%) was greater than that of the Control group (6.7%).

TABLE 7
EFFECT OF 8 WEEK PROGRAM ON FLEXIBILITY MEASUREMENTS

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2 FLEX. (cm)	MEAN	26.8	28.6	27.5	31.7
	$\pm$ sd	10.8	9.3	10.7	10.5
	std. error	2.70	2.48	2.47	2.41

2 significant change over time when both groups' scores were considered together

According to the normative data based on the data base from the Canada Fitness Survey of 1981, the mean trunk flexion values found pre-intervention in the present study for both the Exercise and Control group are below average for the mean age of 41 years. However, following the exercise intervention, the mean trunk flexion measure for the Exercise group improved enough to move the mean group score into the average category for a mean age group of 41 years. The pre-intervention mean trunk flexion values for both the Exercise and Control groups falls within the thirtieth to thirty-fifth percentile for age (mean 41 years) when compared to the 1981 Canada Fitness Survey data. While the Control group moved from the thirtieth up to the thirty-fifth percentile at the post-intervention measuring, the Exercise group moved up

from the near-thirty-fifth percentile to the fifty-fifth percentile due to their mean trunk flexion improvement at post-intervention.

DISCUSSION and SUMMARY for Flexibility Measures

As with the anthropometric data, the non-significant results exhibited in flexibility measures may be due to the short duration of the exercise program. It is noteworthy, however, that (as with much of the anthropometric data) there is a great deal of variance in the flexibility scores, as indicated by the large standard deviation (10.5 for a post-intervention Exercise group score of 31.7 cm) and standard error (2.41). This may be due to the wide age range; in sedentary individuals, flexibility normally declines over time, leading to divergent scores evident in the present study. Additionally, changes in flexibility are less marked following exercise intervention in older participants. Under these conditions, statistical significance may be more difficult to reach.

It has been noted that both the Exercise group and Control group had a pre-intervention mean trunk flexion value that was below the average of the normative data from the 1981 Canada Fitness Survey. Because of the wide age range of the participants in the present study, a mean age value was used in conducting a comparison to this normative data. Inherent problems with this approach include the fact that trunk flexion values do not change systematically with each ten year time frame. Hence a mean age value will not correspond to the same mean trunk flexion norm, if the latter was calculated for individual subjects. However, a comparison to norms (especially those gathered for the Canada Fitness Survey, as it is a nation-wide population pool) is useful to render 'ball-park' comparisons. Lower trunk flexion scores (when compared to normative data) exhibited in the present study may also have resulted from the participants' activity level at pre-intervention; individuals engaged in the study were sedentary and all but one participant worked at a desk all day.

3) Muscular Strength and Endurance

The Muscular Strength and Endurance category includes three measurements: push-ups, sit-ups, and grip strength (combined score for left and right hands). All three of these components were significantly improved over the intervention period when both groups' scores were considered together. The change in the Exercise group over time was significantly different

than that of the Control group in push-ups and sit-ups. Mean pre- and post-intervention muscular strength and endurance values are presented in Table 9.

TABLE 8
EFFECT OF 8 WEEK PROGRAM ON MUSCULAR STRENGTH AND
ENDURANCE MEASUREMENTS

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2,3 PUSH-UPS (#)	MEAN	12.4	13.3	9.3	19.6
	$\pm$ sd	6.4	4.7	8.3	8.4
	std. error	1.61	1.19	1.90	1.92
2,3 SIT-UPS (#)	MEAN	12.8	14.3	8.4	37.4
	$\pm$ sd	16.9	13.2	12.8	28.6
	std. error	4.22	3.29	2.95	6.56
2 COMB. GRIP STR.	MEAN	51.3	53.0	55.3	60.5
	$\pm$ sd	8.9	9.8	10.3	9.6
	std. error	2.23	2.46	2.36	2.20
GRIP STRENGTH (right)	MEAN	26.3	27.0	28.5	30.9
	$\pm$ sd	4.9	5.3	5.6	5.2
	std. error	1.22	1.33	1.29	1.20
GRIP STRENGTH (left)	MEAN	24.8	26.0	26.8	29.6
	$\pm$ sd	4.3	5.0	5.3	4.7
	std. error	1.07	1.25	1.21	1.09

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group score over time when compared to Control

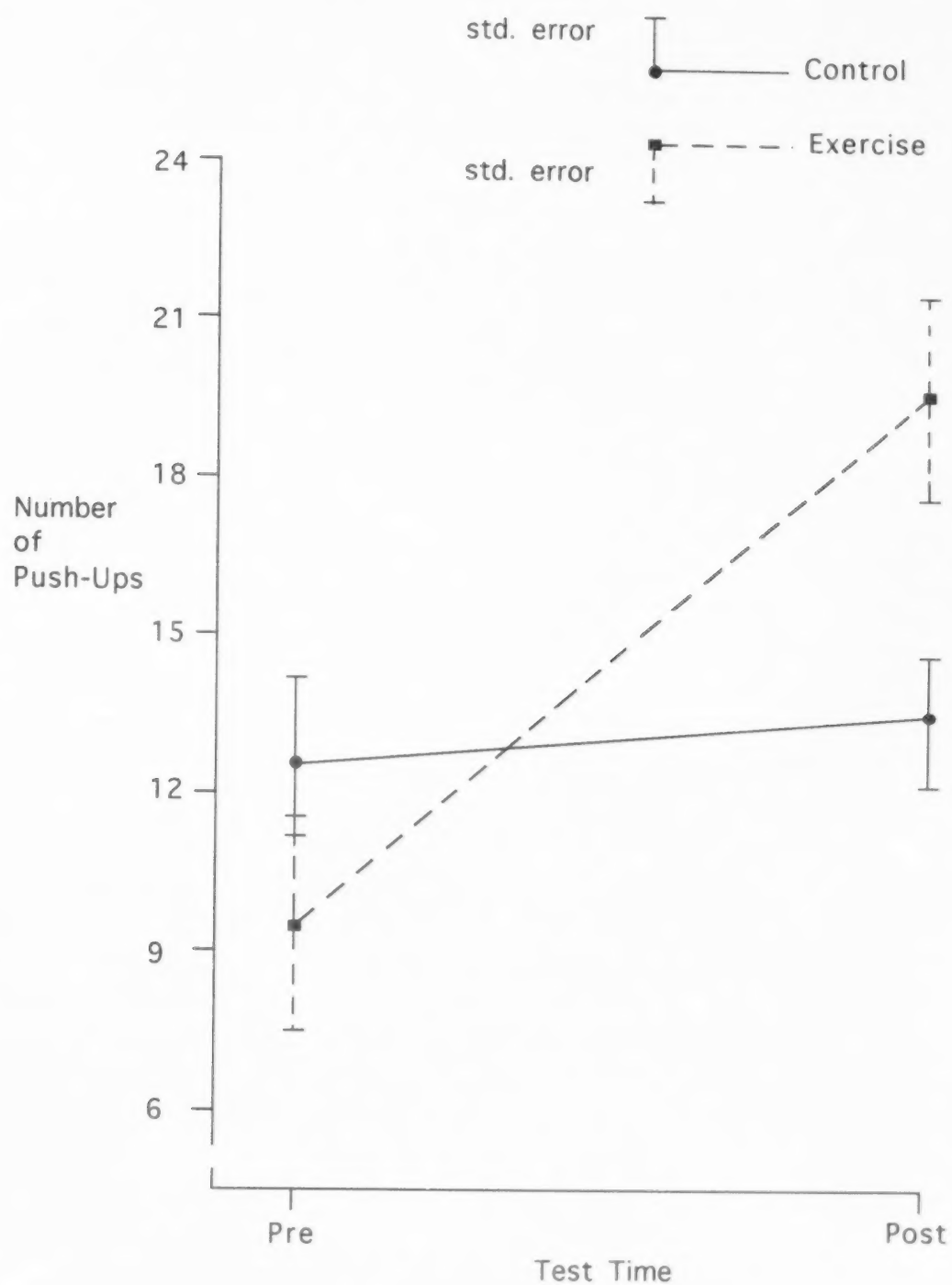


FIGURE 9: The Effect of an 8 Week Program on the Number of Push-Ups Performed

a) Push-Ups

There was a main effect difference in push-up performance among the groups analyzed; the increase in push-ups performed by the Exercise group over the intervention period was significantly different than the increase in push-ups performed by the Control group over time.

The Control group push-up performance improved 7.25% while the Exercise group performance improved 111.8%. Specifically, the Exercise group mean push-up count increased by 10.4 from a pre-intervention count of 9.3 to a post-intervention count of 19.7.

The push-ups performed by the subjects in this study were modified push-ups. When compared to the normative data from the 1981 Canada Fitness Survey, the Control group pre- and post-intervention mean push-up count falls within the average category (for a mean age of 41 years). This push-up count of 12.4 and 13.3 falls within the fiftieth and fifty-fifth percentile range. The Exercise group exhibited a below average performance (within the thirtieth to thirty-fifth percentile) for their mean pre-intervention push-up count. But this performance improved to an above average category and the seventieth to seventy-fifth percentile when the Exercise group's mean post-intervention push-up count doubled to nearly 20 push-ups.

The statistically significant improvement in number of push-ups performed by the Exercise group may be due to the activity-specific nature of the exercise program. The improvement noted may also be attributed to a learning phenomena rather than an actual strength increase. Push-ups were an important component of the muscular strength and endurance portion of the exercise program. Even though the exercise program was short in duration, the participants increased the intensity of the arm muscle work performed over time and this may have contributed to the present results.

b) Sit-Ups

The sit-up scores also exhibited statistically significant changes both over time and between groups. The Exercise group's mean pre-intervention count increased by 29 sit-ups, more than quadrupling their mean pre-intervention sit-up count of 8.4 to a mean post-intervention count of 37.4 sit-ups (a 345.2% increase in the number of sit-ups performed). The Exercise group had a mean post-intervention sit-up count that was 23 sit-ups higher than the Control group mean post-intervention count.

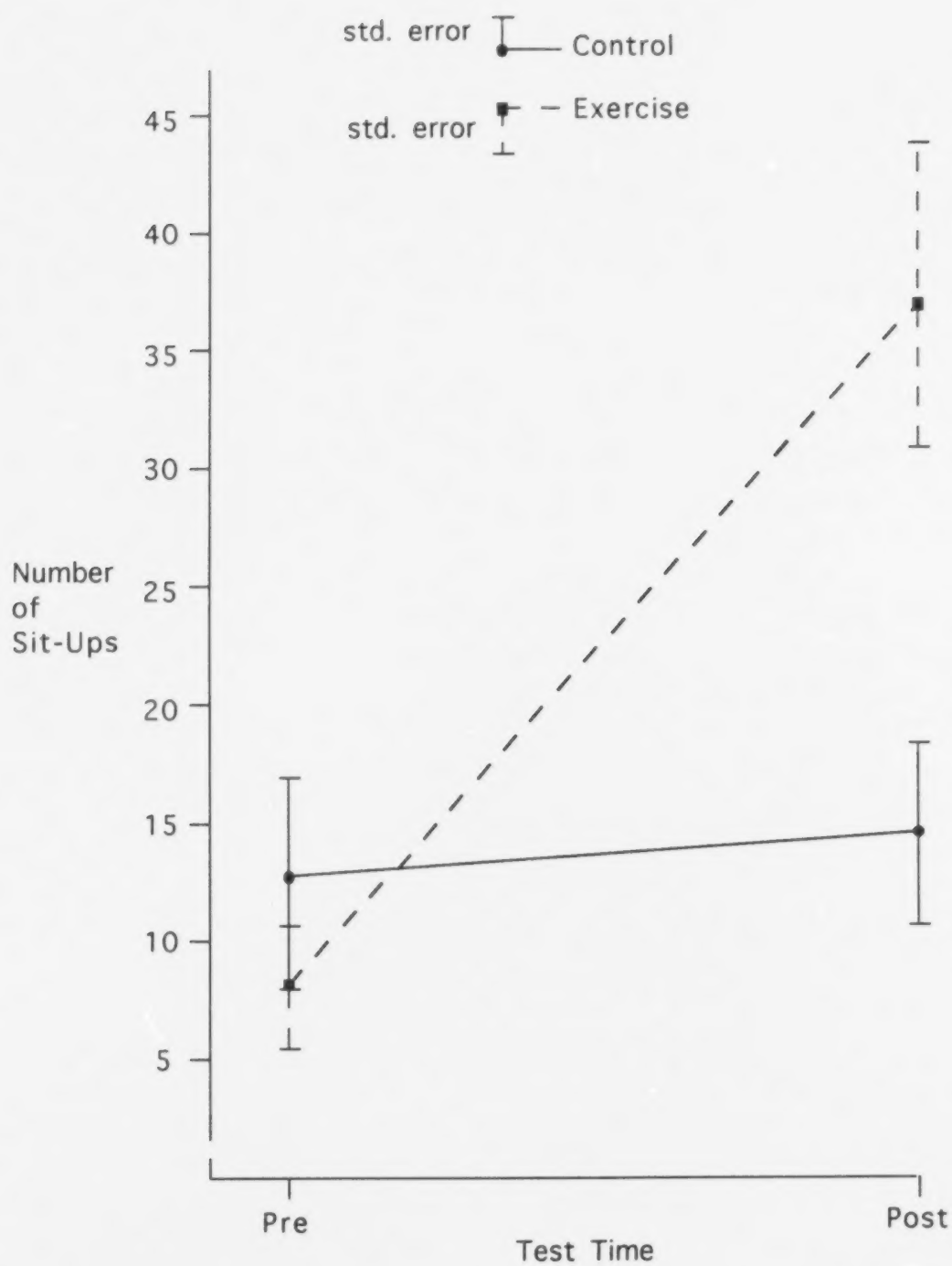


FIGURE 10: The Effect of an 8 Week Program on Number of Sit-Ups Performed

During the exercise program, sit-ups were an important part of the muscular strength and endurance component. The sit-up test, like the push-up test, is activity-specific, relative to the activities performed in the exercise program. The statistically significant increase in the number of sit-ups the Exercise group participants performed at post-intervention was quite likely due to the fact that program participants performed sit-ups during the exercise program. Learning phenomenon may have contributed to the improvement in sit-up performance as well. The mean increase in sit-ups performed by the Control group at post-intervention was not significant.

c) Combined Grip Strength:

The ANOVA indicated statistical significance for changes in mean combined grip strength when both the Exercise and Control group scores were considered together. However, there was no interaction main effect; the increase in the Exercise group's combined grip strength was not significantly different from the change in the Control group's grip strength. The Exercise group exhibited a mean increase of 5.2 kg in combined grip strength at post-intervention. The Control group's mean pre-intervention combined grip strength score improved by 1.7 kg.

When compared to data (for 40 to 49 year old women) gathered in 1981 for the Canada Fitness Survey, both the Exercise and Control group have combined mean right and left hand grip strength scores at pre-intervention that are considered poor (<54 kg) and below average (55 kg-58 kg). While the Control group mean combined right and left hand grip strength score improved from 51.1 kg pre-intervention to a mean post-intervention score of 53.0 kg, the Control group's mean combined grip strength measure did not improve enough to move it out of the "poor" category, as defined by the Canada Fitness Survey 1981 data for 40 to 49 year old women. With a pre-intervention mean score of approximately 51 kg, the Control group was within the fifteenth percentile. At post-intervention, their mean combined grip strength score had improved such that it was higher than twenty percent of combined grip strength measures among a similar population (CSTF Operations Manual, 1986).

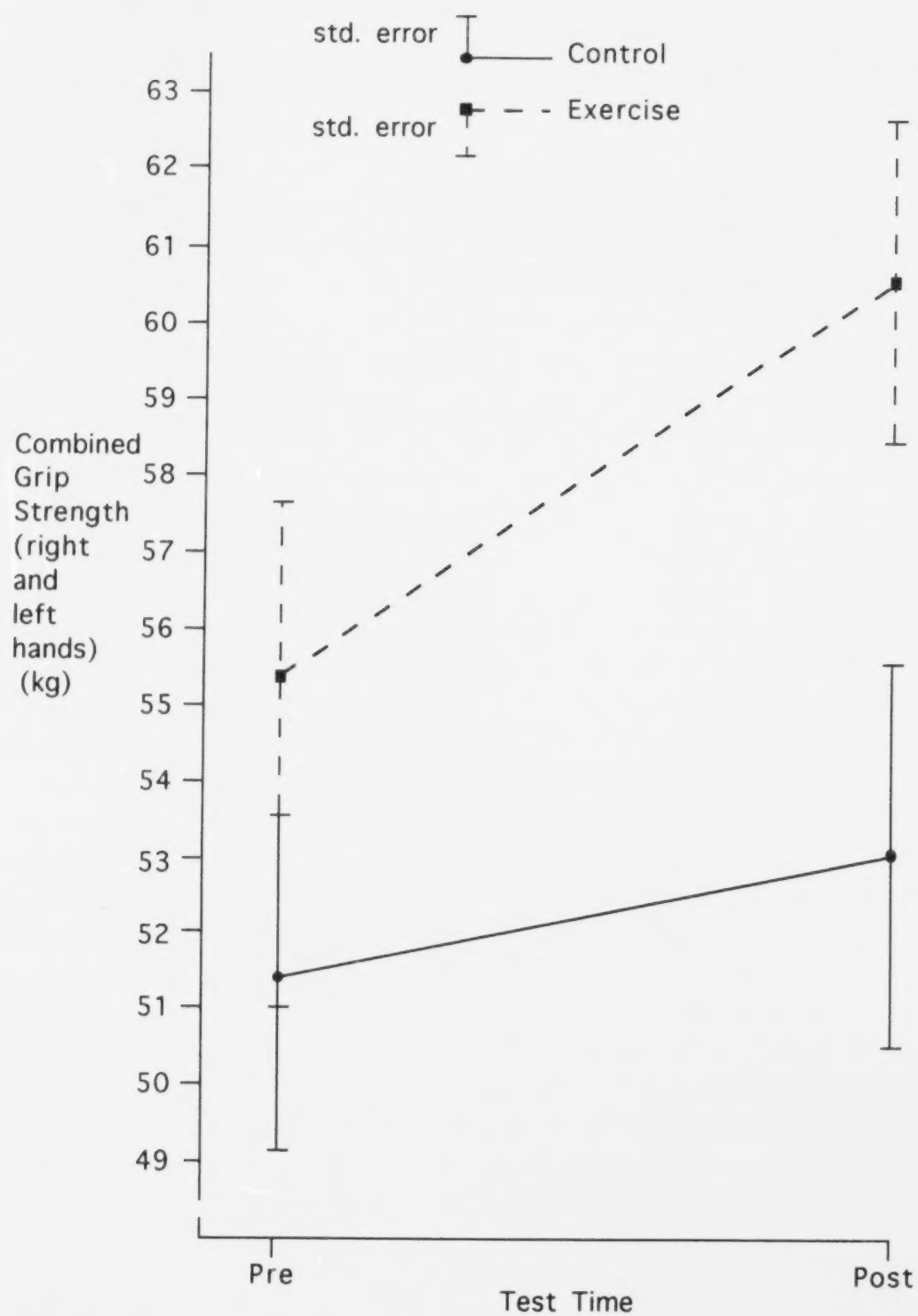


FIGURE 11: The Effect of an 8 Week Program on Combined Grip Strength (right and left hand)

By improving their pre-intervention mean combined score from 55.3 kg to a mean post-intervention measure of 60.5, the Exercise group moved from the bottom end of the below average level (51-54) to the bottom end of the above average scale (59-64) when compared to the Canada Fitness Survey data matched for gender and average age. At a pre-intervention mean combined score of approximately 55 kg, the Exercise group was within the twenty-fifth percentile. At post-intervention assessment, the Exercise group mean combined score had improved to approximately 60.5 kg. This score was higher than the combined grip strength score achieved by approximately seventy-one percent of a similar population. This improvement exhibited by the Exercise group at post-intervention probably resulted from activities engaged in, such as push-ups, part of the muscular strength and endurance component of the exercise program.

DISCUSSION and SUMMARY for Muscular Strength and Endurance

The tests used to assess muscular strength and muscular endurance (i.e. sit-up count, push-up count, and grip strength measures) are tests of functional strength and endurance. It is noteworthy that of the four components of physical fitness measured for this study, measures of muscular strength and muscular endurance have exhibited the most statistically significant difference between treatment groups. This may, in part, be due to the specific nature of the activities done during the exercise program; both push-ups and sit-ups comprised an essential part of the exercise program and these were the tests used to indicate arm and abdominal strength, respectively.

The push-up test is designed to measure the strength and endurance of the muscle groups used in moving the weight of the body (Getchell, 1983). The push-ups done during the exercise program increased muscular strength and muscular endurance in a number of upper body muscle groups, including the shoulder area and upper arm, and, to a lesser extent, the forearm. More specifically, the push-up improved muscular function in muscles that extend the arm anteriorly. With the added resistance of the body weight, the Exercise group improved the strength and endurance of the chest, shoulders, and forearm muscle groups. Improved muscular strength and endurance in these muscles was reflected in the significant improvement in Exercise group post-intervention mean push-up count. The mean number of push-ups the Exercise group was able to perform more than doubled whereas the Control group

improved their push-up performance by a mean of 0.9 push-ups at post-intervention assessment.

An increase in abdominal muscle strength and endurance is suggested by the significant increase in the mean number of sit-ups the Exercise group was able to perform at post-intervention assessment.

The sit-up test evaluates the strength and endurance of the muscle groups used primarily in moving the weight of the body through a curl-up motion (Getchell, 1983). The muscles involved in this movement include the trunk flexors: the transversus abdominis, rectus abdominis, internal obliques, and external obliques. Sit-ups were an important component of the muscular strength and endurance aspect of the exercise program. The mean number of sit-ups the Exercise group was able to perform post-intervention was almost five times the number the group was able to perform pre-intervention. The marked improvement in sit-up count exhibited by the Exercise group suggests that muscular strength and endurance in the abdominal region increased significantly. Learning phenomenon may also have contributed to the observed increase in number of sit-ups performed; with a sedentary population not accustomed to performing sit-ups or push-ups, it is likely that the practice the Exercise group received in sit-ups and push-ups improved that group's ability and efficiency of performance.

Grip strength in combined right and left hands increased for both the Exercise and Control group; the Exercise group change was not significantly different from that of the Control group. The hand grip dynamometer test for grip strength measures muscular strength in the forearm flexors and hands. Of the three tests assessing muscular strength and endurance, the hand grip test is least activity specific relative to the activities performed during the exercise program. The improvement in hand grip strength in the Exercise group post-intervention may be due to an increase in muscular strength and endurance in some of the forearm flexors. An increase in forearm flexor strength may be due to the push-ups done during the exercise program.

Physiological adaptations associated with muscular strength and endurance following exercise training include:

1. enhanced neuromuscular recruitment,
2. hypertrophy of muscle, and
3. enhanced metabolic capacity of muscle.

From a metabolic perspective, more mitochondria are available, resulting in an increased capacity of the muscle to supply ATP (Pendergast et al., 1979; Taylor, 1975). An increase in the actin-myosin cross-bridges increases the force generation capacity (Clark, 1973; Gollnick and Hermansen, 1973) and a reduction in the number of motor units used to perform submaximal exercise (Caizzo and Kyle, 1980). Cardiovascular adaptations include an increase in capillary beds (improving the muscles's efficiency in extracting oxygen and removing wastes from working muscles), improved temperature regulation, increased tolerance to lactic acid levels for longer periods of time, decreased blood flow to the working muscles in proportion to the severity of muscle contraction during exercise, and a decrease in blood supply to the trained muscles (with the same or greater power output) (Caizzo and Kyle, 1980; Clark, 1973; di Prampero, 1973; Fox, 1975; Gollnick and Hermansen, 1973; Hermansen, 1981; Pendergast et al., 1979; Saltin and Essen, 1971; Taylor, 1975). Direct evidence of physiological adaptations (such as those mentioned above) among the Exercise group following training has not been measured. However, indirect evidence of physiological improvements in muscle recruitment and metabolic function following training is suggested by the significant increases in functional performance (i.e. increased numbers of push-ups and sit-ups performed before exhaustion; greater grip strength) exhibited by the Exercise group. Improvements in function suggest physiological adaptations that would enable such improvements.

4) Cardiovascular Function:

Cardiovascular function was assessed with the Sjostrand Physical Work Capacity (PWC₁₇₀) cycle ergometer test. As a predictive test, it can only indirectly indicate cardiorespiratory fitness by measuring heart rate response to a known submaximal exercise stress. Improved cardiovascular function is indicated by a lowered resting heart rate, an ability to pedal a greater resistance without a concomitant greater heart rate increase, and an increased predicted maximal volume of oxygen uptake ($\dot{V}O_2$ max). These improvements suggest an improved ability of the heart to pump blood to the working muscles, and the muscles to utilize oxygen (Getchell, 1983; Katch and Macardle, 1982; Lamb, 1984).

Mean pre- and post-intervention PWC₁₇₀ and predicted $\dot{V}O_2$ maximum values are presented in Table 10. Mean pre- and post-intervention resting

heart rate values are presented in Table 11. Mean pre- and post-intervention resting blood pressure values are presented in Table 12.

TABLE 9
EFFECT OF 8 WEEK PROGRAM ON PWC₁₇₀ AND PREDICTED V02
MAXIMUM

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2 PWC ₁₇₀	MEAN	8.16	8.84	9.15	10.26
kpm/kg/min	$\pm$ sd	2.7	2.9	2.4	2.7
relative	std. error	0.70	0.75	0.56	0.64
2 PWC ₁₇₀	MEAN	546.0	570.0	610.8	676.4
kpm/min	$\pm$ sd	147.9	150.9	147.7	173.3
absolute	std. error	38.19	38.97	34.81	40.84
2,3 PRED.	MEAN	27.55	27.00	26.59	31.09
V02 max.	$\pm$ sd	8.6	9.9	7.1	7.8
kpm/kg/min	std. error	2.21	2.56	1.67	1.85

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group scores over time when compared to Control

a) PWC₁₇₀ Cycle Ergometer Test (absolute and relative scores):

A significant increase was observed over time for both PWC₁₇₀ relative and absolute when both the Exercise and Control group scores were considered together. However, the Exercise group's increase in PWC₁₇₀ scores was not significantly different from the increase in scores for the Control group over time; no interaction effect was evident.

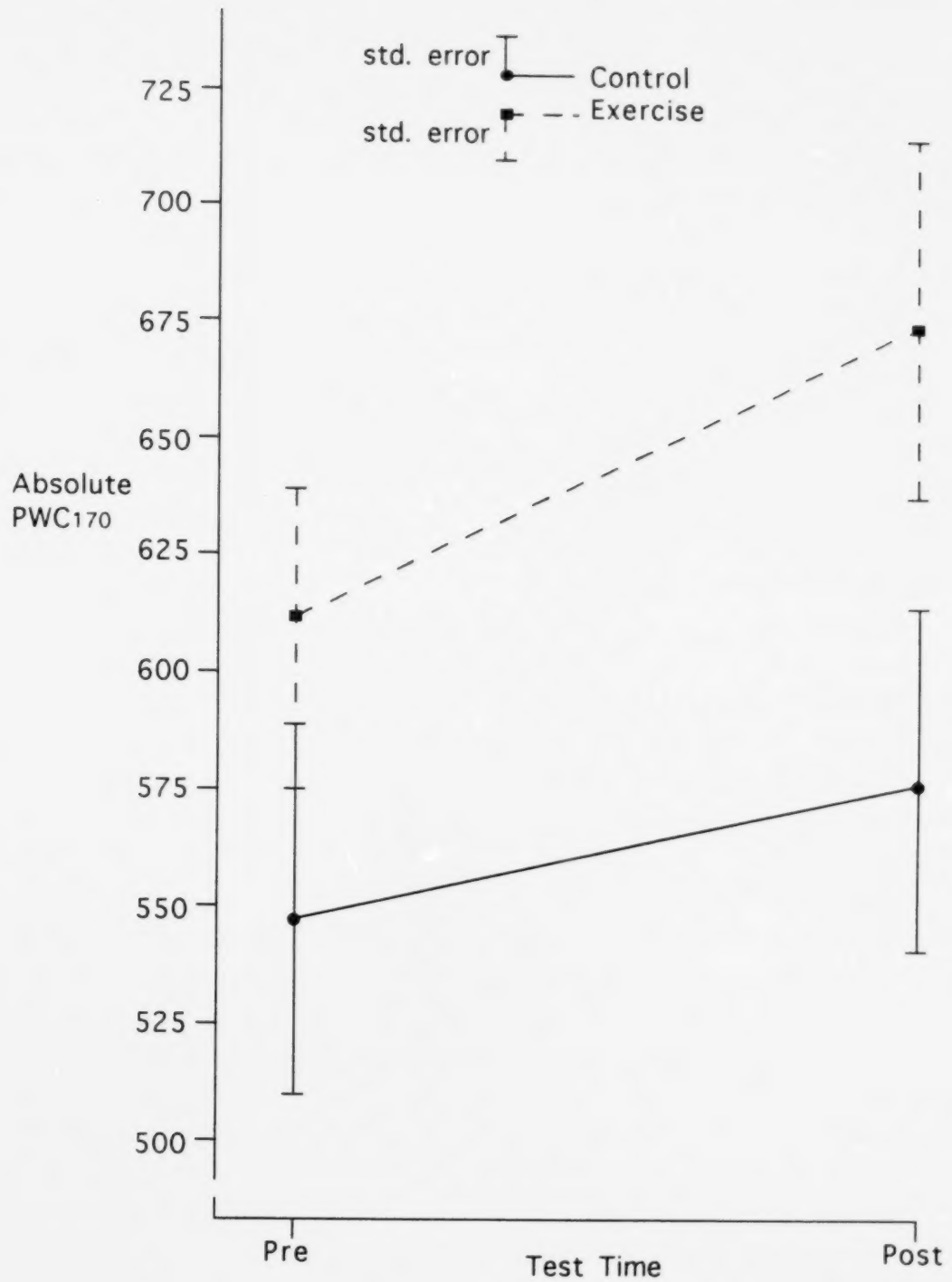


FIGURE 12: The Effect of an 8 Week Program on Predicted Work Capacity (PWC₁₇₀ Absolute)

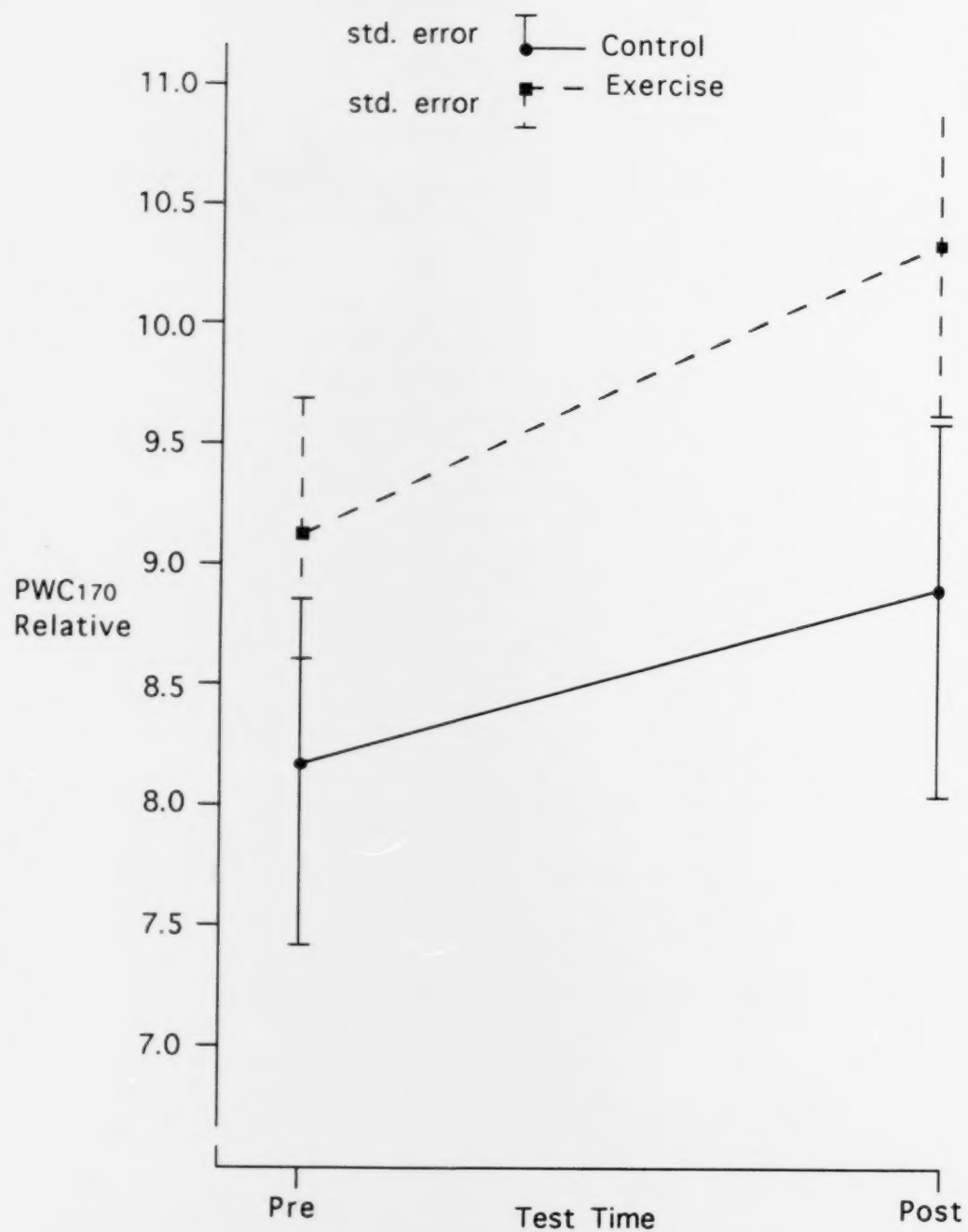


FIGURE 13: The Effect of an 8 Week Program on Predicted Work Capacity (PWC 170 Relative)

Both the Control and Exercise group exhibited an improvement in cardiorespiratory function over time, as indicated by the increase in both absolute and relative PWC₁₇₀ for both groups. While the improvement in PWC₁₇₀ (both relative and absolute) in the Exercise group was greater than that in the Control group, this difference did not reach statistical significance. Absolute PWC₁₇₀ increased 24 kpm/min in the Control group (a 4.4% improvement) and 65.6 kpm/min (a 10.7% improvement) in the Exercise group. Relative PWC₁₇₀ increased 0.68 kpm/kg/min in the Control group (an 8.3% improvement) and 1.11 kpm/kg/min (a 12.1% improvement) in the Exercise group. The wide variance in scores may have contributed to the lack of significance in the results; at post-intervention, the Exercise group exhibited a standard error of 40.84 and standard deviation of 173.3 for the relative PWC₁₇₀ score.

The unexpected improvement in PWC₁₇₀ in the Control group may be due to the increased activity level with the onset of spring and early summer. As has been mentioned previously, some participants of the Control group reported (informally) that they engaged in more (unorganized) physical activity over the intervention period.

The improvement in the Exercise group's PWC₁₇₀ score was not greater probably because of the moderate intensity (cardiovascular work consisted of brisk walking for 20 to 40 minutes three times per week) and short duration (eight weeks) of the program.

b) Predicted Maximal Volume of Oxygen Uptake (V_{O2} max):

The Sjostrand PWC 170 (modified) test is a predictive test designed to estimate maximal oxygen consumption (V_{O2} max). An estimate of maximal cardiovascular function can be made from heart rate, ventilation rate, and other variables during standardized exercise loads (Fox, 1973; Nagle, 1973). Based upon the linear relationship between heart rate and oxygen consumption, the Sjostrand predictive cycle test allows an estimation of aerobic power without compromising the subject with an exhaustive test. As Astrand (1954) asserts, a linear increase in metabolism occurs when the heart rate increases from approximately 125 to 170 beats per minute with increasing resistance.

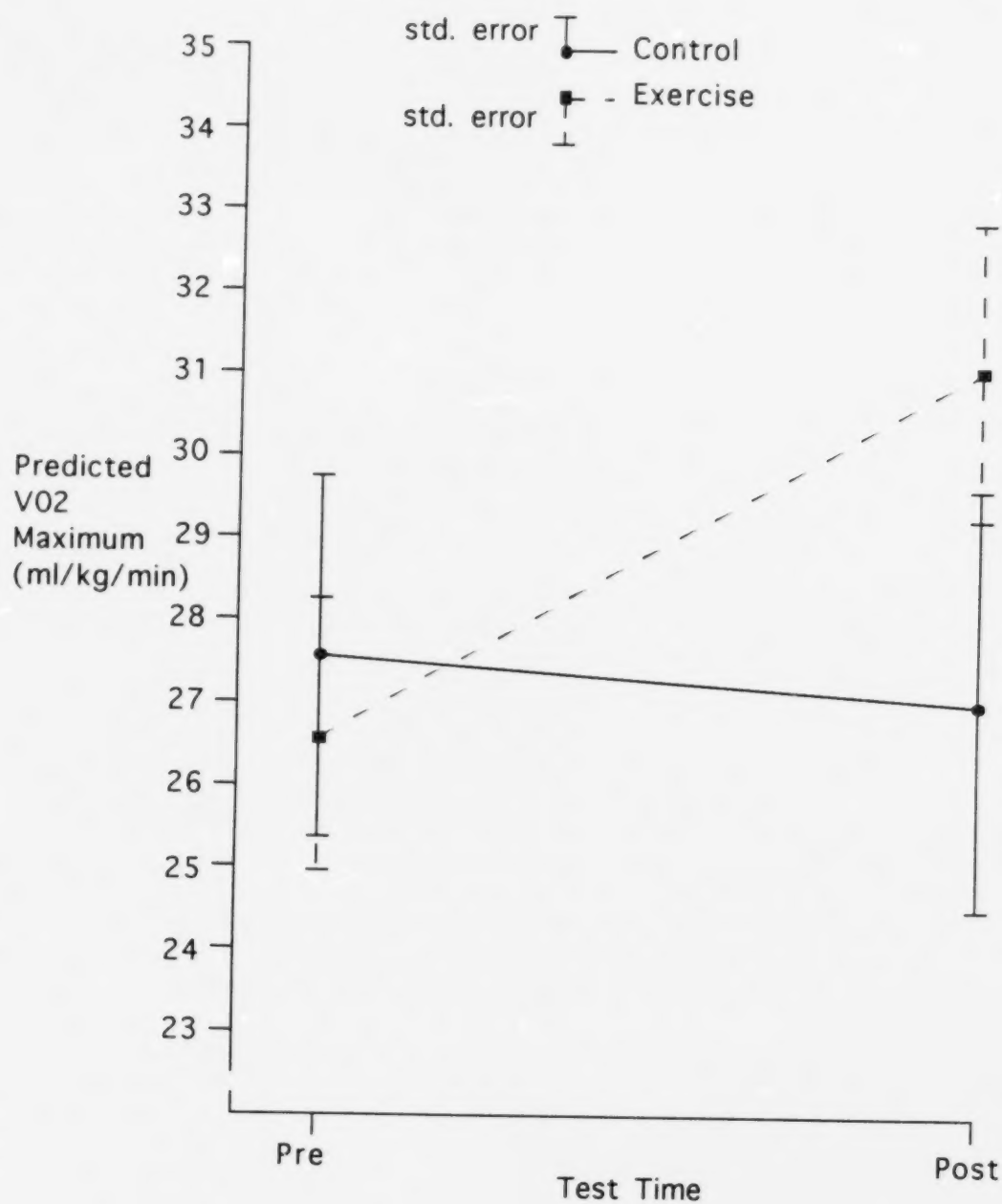


FIGURE 14: The Effect of an 8 Week Program on Predicted Volume of Oxygen Uptake (V02 max)

The ANOVA revealed statistically significant differences between and within groups ($p < 0.05$). When both Exercise and Control group scores for predicted $\dot{V}O_2$ max were considered together, there was a significant change over time. Additionally, the increase in predicted $\dot{V}O_2$ max over time in the Exercise group was significantly different than the change in predicted $\dot{V}O_2$ max in the Control group over time.

There was a 16.9% increase in predicted maximal volume of oxygen consumption for the Exercise group at post-intervention assessment. Specifically, the Exercise group mean predicted $\dot{V}O_2$ max increased by 4.5 ml/kg/min. Conversely, the Control group's mean predicted maximal volume of oxygen uptake decreased 0.55 ml/kg/min (a 2% reduction). There was a notable difference in mean predicted $\dot{V}O_2$ max between the Control group and Exercise group at post-intervention. The Exercise group's mean predicted $\dot{V}O_2$ max at post-intervention (at 31.09 ml/kg/min) was 4.09 ml/kg/min greater than the Control group's mean predicted $\dot{V}O_2$ max at post-intervention (at 27.00 ml/kg/min). At pre-intervention, no difference between the Control and Exercise group was evident. The Control group's mean predicted $\dot{V}O_2$ max (at 27.55 ml/kg/min) was 0.96 ml/kg/min higher than the Exercise group's mean predicted $\dot{V}O_2$ max (at 26.59 ml/kg/min) at pre-intervention assessment.

$\dot{V}O_2$ max refers to the maximal volume of oxygen that can be taken and transported to working muscle per minute during exhaustive exercise. Maximal oxygen consumption refers to the greatest difference between the rate inspired oxygen enters the lungs and expired oxygen leaves the lungs during exercise (Lamb, 1984). An increase in maximal oxygen consumption, or aerobic power, suggests that more oxygen is being used by the active tissues. This occurs when the electron transport system of the mitochondria more efficiently produce energy for the active muscles, a result of aerobic training. Other factors of cardiovascular function that may have improved in the Exercise group following exercise training (as suggested by the improved predicted $\dot{V}O_2$ max for this group at post-intervention) include heart function (stroke volume), effective circulation of blood to the active tissues, and extraction and utilization of oxygen at the active tissue sites (Lamb, 1984).

Predictions of maximal oxygen uptake have inherent limitations, such as prediction error of approximately ten per cent (Nagle, 1973), leading to an under- or over-estimation of maximal oxygen uptake of ten per cent. According to Bruce (1974), predictive tests that use a predetermined heart rate that

represents a percentage of predicted maximal heart rate for the subject can be problematic because of the wide range of maximal heart rates for each age group. However, the advantages of predictive tests (e.g. safety for a sedentary group of diverse age, etc.) compared to exhaustive maximal oxygen tests with a population such as the one in the present study outweighed the disadvantages (e.g. margin of error, etc.). Another limitation is the low correlation ($r=0.55$) recorded by Taylor et al. (1963) between $\dot{V}O_2$ max and the Sjostrand PWC₁₇₀ cycle test. Taylor et al. (1963) attribute this low correlation to limiting quadricep strength and mechanical efficiency.

TABLE 10: EFFECT OF 8 WEEK PROGRAM ON CARDIOVASCULAR FUNCTION: RESTING HEART RATES

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
RESTING	MEAN	85.6	85.4	92.2	87.0
HRT. RATE	$\pm$sd	13.7	10.4	12.9	8.5
(bpm)	std. error	3.53	2.68	3.04	1.99

c) Resting Heart Rate (RHR):

The changes in resting heart rate did not achieve statistical significance. The mean resting heart rate for the Control group did not change between the pre- and post-intervention assessment. The Exercise group's mean resting heart rate decreased from a pre-intervention mean heart rate of 92.2 bpm to a mean post-intervention resting heart rate of 87 bpm (a decrease of 5.2 bpm in mean RHR). Astrand and Rodahl (1977) and Pollock (1973) have suggested that resting heart rate may be expected to decrease by 5 to 10 beats per minute in most individuals involved in a cardiovascular training program. However, resting heart rate is a very difficult parameter to accurately and reliably measure. Resting heart rate can change considerably from moment to moment with excitement levels. Factors such as amount of caffeine ingested can also alter results.

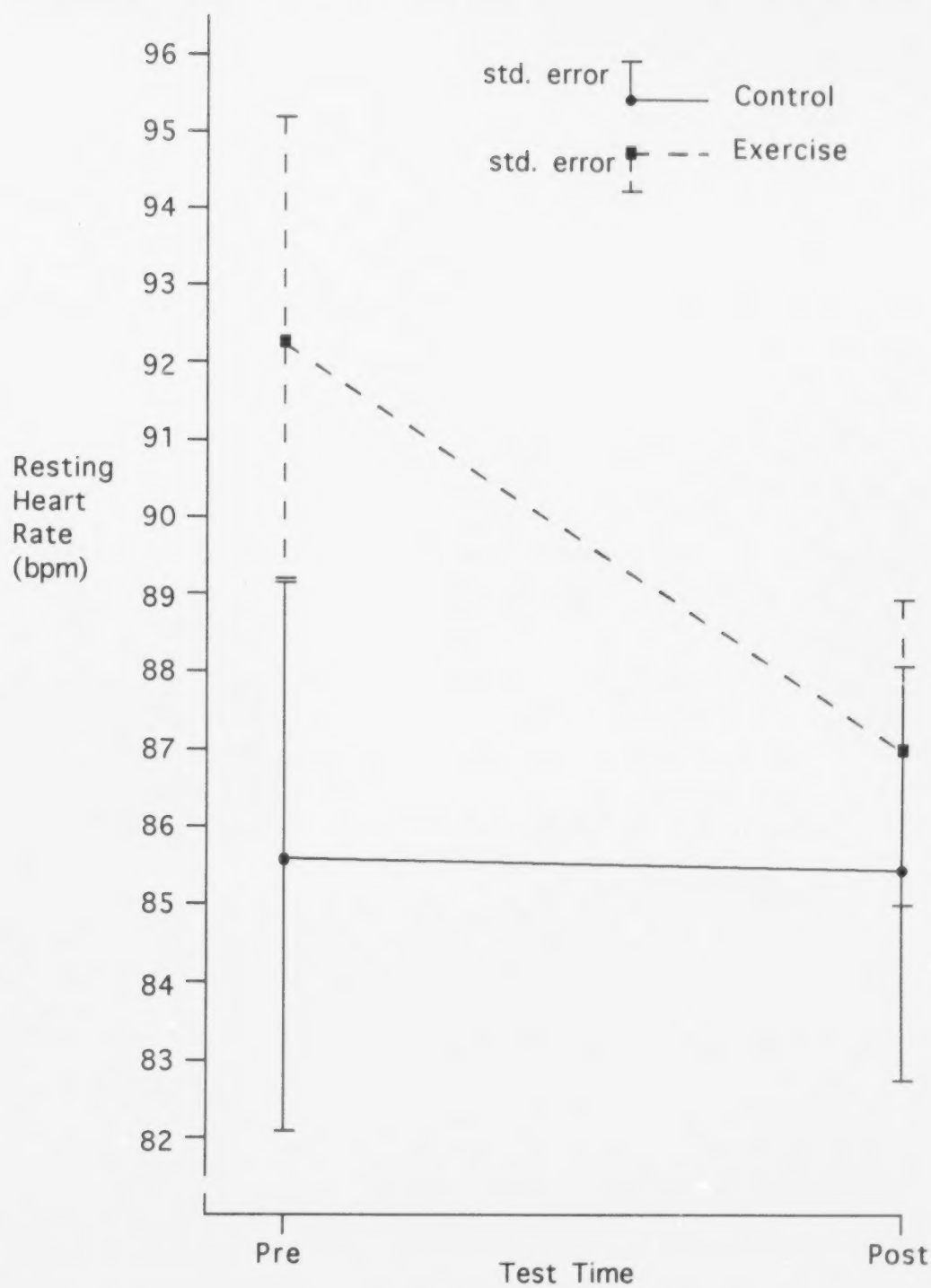


FIGURE 15: the Effect of an 8 Week Program on Resting Heart Rate (RHR)

TABLE 12
EFFECT OF 8 WEEK PROGRAM ON RESTING BLOOD PRESSURE

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
BP REST systole	MEAN	113.1	108.1	106.8	110.8
	$\pm$sd	19.4	17.6	17.3	19.1
	std. error	5.01	4.54	4.07	4.50
BP REST diastole	MEAN	65.2	63.3	62.9	67.6
	$\pm$sd	13.5	10.5	15.2	9.5
	std. error	3.47	2.72	3.59	2.23

d) Resting Blood Pressure:

There was no significant difference in either systolic or diastolic blood pressures between the Control or Exercise groups pre-intervention or post-intervention. According to Choquette and Ferguson (1973) and Pollock (1973), exercise programs are most effective in lowering arterial blood pressure in older participants or individuals with hypertension. Because of the wide age range in the present study, it is difficult to assess what the role was of lowering blood pressure in older participants post exercise program. A comparison of individual arterial blood pressures within each group might address this aspect of cardiovascular function.

DISCUSSION and SUMMARY for Cardiovascular Function

There is some evidence for improved cardiovascular function in the Exercise group following exercise training intervention. The significant improvement in the Exercise group's predicted V02 max (when compared to the change in the Control group) at post-intervention suggests improved cardiovascular function in the Exercise group over time.

One of the most comprehensive indications of cardiorespiratory fitness improvement is the predicted maximal volume of oxygen uptake (as measured in this study by the PWC₁₇₀ cycle ergometer test). The increase in this parameter exhibited by the Exercise group was significantly greater than the change in the Control group over time; the Exercise group improved by seventeen percent (17%) in mean predicted maximal oxygen uptake at post-intervention assessment. These results suggest that the Exercise group may have experienced some improvements in cardiorespiratory factors following exercise intervention, such as the "...ability of the heart to deliver blood to the working muscles and the ability of the circulation to shift blood from nonworking regions of the body to working muscles" (Lamb, p. 205, 1984).

According to a number of researchers, improvements of fifteen to twenty percent in maximal oxygen consumption are not uncommon in previously untrained males who undertake aerobic endurance training (Astrand and Rodahl, 1977; Pollock, 1973; Saltin, 1969). This corresponds with the degree of change exhibited in the present study. Previously sedentary participants tend to improve greatly in cardiovascular function following aerobic training as they approach their potential (Astrand and Rodahl, 1977; Pollock, 1973; Saltin, 1969). Greater improvements in cardiorespiratory function may have occurred in the present study with a more intense, longer exercise program.

The Exercise and Control groups in the present study were not only initially sedentary, they were also composed of individuals of divergent age. Both groups had a mean age of 41 years; the range was 23 to 60 years. Age plays a role in the cardiovascular system's rate of improvement following training; this may be due to decreased activity levels as well as the aging process. As the participant grows older, maximal cardiac output falls, maximal heart rate decreases, and maximal pulmonary ventilation during exercise of short duration is reduced (the latter due to stiffening of the joints in the rib cage following connective tissue changes which causes gradual deterioration in lung and bronchial structure and increased airway resistance) (Astrand and Rodahl, 1977; Shephard, 1972). With such a diverse age range in the present study, the rate of cardiovascular improvement in the Exercise group following training may have been flattened. The wide age range may also have contributed to the variability observed. Other factors that have probably affected the degree of cardiovascular improvement noted in the Exercise group following training include the type and intensity of training. As Pechar et al. (1978) note, training-

induced adaptations are specific to the activity engaged in. For example, the ability of muscles to extract oxygen from the blood and improvements in local circulation to the working muscles are training-induced adaptations that occur in the stressed muscles. In the present study, the muscles stressed during the aerobic component of the training program were primarily those involved in walking. The test of aerobic function in this study involved stressing the cardiovascular system on a bicycle; the cycle test may not have effectively tested those muscles most aerobically adapted following training. However, the quadricep group and other muscles involved in bicycle work were stressed during the muscular strength and endurance component of the exercise program.

One of the limiting factors cited for the bicycle test is quadricep muscle group fatigue (Taylor et al., 1963). The specific training of these muscles in the exercise program may have improved the Exercise group's ability to maintain a higher workload on the bicycle test. This was suggested by the statistically significant (see Appendix for statistical analysis) increase in mean power output the Exercise group was able to sustain in the final four minutes of the exercise test at post-intervention (an increase of 18% from pre- to post-intervention) and in average power output (a 14.5% increase at post-intervention). (See Appendix M for graphs of power output and maximum heart rate achieved during the cycle test). This is a further indication of both cardiovascular function improvement and improvement in the physiological function of the muscles specifically involved in bicycle work in the Exercise group following exercise training. In the Exercise group, the power output sustained throughout the test and during the final four minutes was increased much more than the maximal heart rate reached during the test. Conversely, the Control group's power output sustained during the final four minutes of the test increased by 1.6%.

It is evident that the Exercise group was able to increase the power output during the final four minutes of the test (18% versus 1.6% for the Control group) at post-intervention (following training) without increasing the heart rate to the same degree (4.4% versus 3.2% for the Control group). The physiological adaptations involved in this cardiovascular function improvement include decreased heart rate, increased stroke volume, decreased blood pressure during submaximal exercise (and at rest for older individuals), decreased sympathetic vasoconstriction in non-exercising tissue, decreased

cardiac output required for submaximal exercise, improved oxygen transport capacity, improved oxidative metabolic capacity of skeletal muscle cells, increased oxygen consumption capacity, increased blood volume, increased production of red blood cells, decreased lactic acid produced during submaximal work, increased glycogen stores, increased maximal arteriovenous oxygen difference, decreased venous oxygen content during maximal exercise (because more oxygen is utilized due to improved efficiency), and increased venous carbon dioxide content during maximum exercise. Some of the physiological mechanisms responsible for these adaptations include the increase in stroke volume (Astrand and Rodahl, 1977; Rowell, 1975; Saltin, 1969) caused by greater diastolic filling of an enlarged heart (the heart has a greater blood volume to force out) (Stein et al., 1980; Zeldis et al., 1978), reduced heart rate (more time for the ventricle to fill with blood) (Wolfe et al., 1979), and improved cardiac contractility (following training, the sarcolemma in the heart muscle fibers may be able to bind more calcium from the extracellular fluid, causing troponin in the muscle cell to initiate more cross bridge formation) (Barnard et al., 1975; Barnard et al., 1980; Schaible et al., 1979; Tibbits et al., 1981). An increase in stroke volume may increase maximal cardiac output after training, and according to Astrand and Rodahl (1977), Rowell (1975), and Saltin (1969), increased maximal cardiac output is responsible for the majority of the increase in maximal oxygen consumption noted following aerobic training. Increased rate of oxygen extraction from the blood by the working muscles may increase maximal arteriovenous oxygen difference following exercise training, which may improve maximal oxygen uptake (Cunningham et al., 1979). According to Rowell (1975), increased oxygen extraction following training may be caused by enhanced diffusion of oxygen from capillary to muscle (due, perhaps, to greater stores of myoglobin in trained muscles), a greater number of capillaries per muscle fiber, and greater efficiency of trained muscle mitochondria in utilizing oxygen. Mitochondrial adaptations, including increased numbers and/or size of mitochondria, increased electron transport system, improved ability of the trained mitochondria to produce ATP, and increased mitochondrial enzyme activities and amounts, may lead to increased oxygen extraction in the trained muscles, leading to increased maximal oxygen uptake (Holloszy and Booth, 1976; Holloszy, 1973). During submaximal exercise, mitochondrial adaptations due to training, such as an increased number and/or size of mitochondria, may mean that the trained muscle requires less adenosine

di-phosphate (ADP) to consume the same or more oxygen while working. According to Hagberg et al. (1980) and Holloszy and Booth (1976), lower concentrations of ADP mean that aerobic ATP (adenosine tri-phosphate) levels can reach a steady state more quickly, with less anaerobic glycolysis, oxygen debt, and lactic acid production. Lower lactic acid rates due to training adaptations have other benefits as well. Decreased pulmonary ventilation rate (per liter of oxygen uptake) following training may be due to reduced levels of lactic acid in the blood (trained individuals rely more on aerobic metabolism) because a drop in the pH level stimulates ventilation (Astrand and Rodahl, 1977; Martin et al., 1979).

Researchers note that a decrease in resting blood pressure in older individuals attributed to exercise training can be expected (Choquette and Ferguson, 1973; Pollock, 1973). A slight decrease in the Exercise group's post-intervention mean resting blood pressure was noted (a 3.8% decrease in mean resting systolic pressure, and a 7.3% decrease in mean resting diastolic blood pressure). When compared to the changes observed in the Control group, however, this was not statistically significant.

B. PSYCHOLOGICAL PARAMETERS

Following the repeated measures two-way ANOVA statistical analysis, a number of psychological parameters exhibited statistically significant changes over time ($p < 0.05$). A significant difference was found between the groups at pre-intervention in self-efficacy (including self-efficacy for aerobic dance/exercise and stair-climbing). When both groups' scores were considered together pre- and post-intervention, self-efficacy (including all four components of self-efficacy), physical competence, physical acceptance, and hope (including the three factors comprising hope) all exhibited significant changes ($p < 0.05$). The Exercise group exhibited significantly more change than did the Control group over time ($p < 0.05$) in the following parameters: self-efficacy (including self-efficacy for aerobic dance/exercise, stair-climbing, and lifting designated loads), physical competence, physical acceptance, and hope (including Factor 1, Factor 2, and Factor 3).

Regression analyses were conducted between physiological parameters and psychological parameters, and between psychological parameters. The parameters regressed included:

- weight,
- five skinfold measures (i.e. tricep, bicep, subscapula, suprailiac, and front thigh),
- waist and thigh girth measures,
- Body Mass Index (BMI),
- Sum Of Skinfolks (SOS),
- Waist to Hip Ratio (WHR),
- Sum Of Trunk Skinfolks (SOTS),
- push-ups,
- sit-ups,
- combined grip strength,
- flexibility,
- PWC₁₇₀ relative and absolute,
- predicted V02 max,
- self-efficacy (and its four components),
- self-competence,
- self-acceptance,
- global self-esteem,
- locus of control, and
- hope (and the three factors comprising the total hope score).

Specific psychological parameters are dealt with under designated categories following. A discussion and summary follows each category.

1) Questionnaire 1: Physical Self-Efficacy

Questionnaire 1: physical self-efficacy measured the subjects' competence judgement in the activities outlined in the questionnaire (based on a questionnaire developed by Ewart et al., 1983 and Taylor et al., 1985, for cardiac patients). These included perceived self-efficacy for walking, aerobic dance/exercise, climbing flights of stairs, and lifting described quantities of weight. Degree of work for each item was designated with a scale of increasing workload or duration. The strength and direction of perceived physical self-efficacy was assessed with grades of certainty from one to ten, one representing very certain to ten representing very uncertain (see Appendix E for Questionnaire 1). Results for the four specific exercises will be discussed under designated categories (i.e. Walking; Aerobic Dance/Exercise; Stair-Climbing;

Weight-Lifting). Mean pre- and post-intervention scores for Q1: Self-Efficacy are presented in Table 13.

TABLE 12
EFFECT OF 8 WEEK PROGRAM ON PHYSICAL SELF-EFFICACY
 (higher score indicates lower physical self-efficacy)

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
1,2,3 SELF-EFFICACY (physical)	MEAN	179.8	171.3	166.4	105.2
	$\pm$ sd	53.2	56.4	50.6	60.3
	std. error	13.30	14.10	11.60	13.84
2,3 for walking	MEAN	22.4	19.0	25.8	14.4
	$\pm$ sd	16.9	16.2	22.2	17.2
	std. error	4.22	5.10	4.05	3.94
1,2,3 for aerobic dance/ex.	MEAN	61.9	61.7	57.8	36.9
	$\pm$ sd	18.9	18.2	22.0	22.5
	std. error	4.72	4.56	5.06	5.17
1,2,3 for climbing stairs	MEAN	55.8	53.4	44.7	29.8
	$\pm$ sd	13.4	18.0	16.2	18.7
	std. error	3.35	4.49	3.71	4.28
2,3 for lifting weight	MEAN	39.7	37.3	38.1	23.9
	$\pm$ sd	18.7	16.9	18.4	16.1
	std. error	4.68	4.22	4.22	3.69

1 significant difference between Exercise and Control groups at pre-intervention

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group scores over time when compared to Control

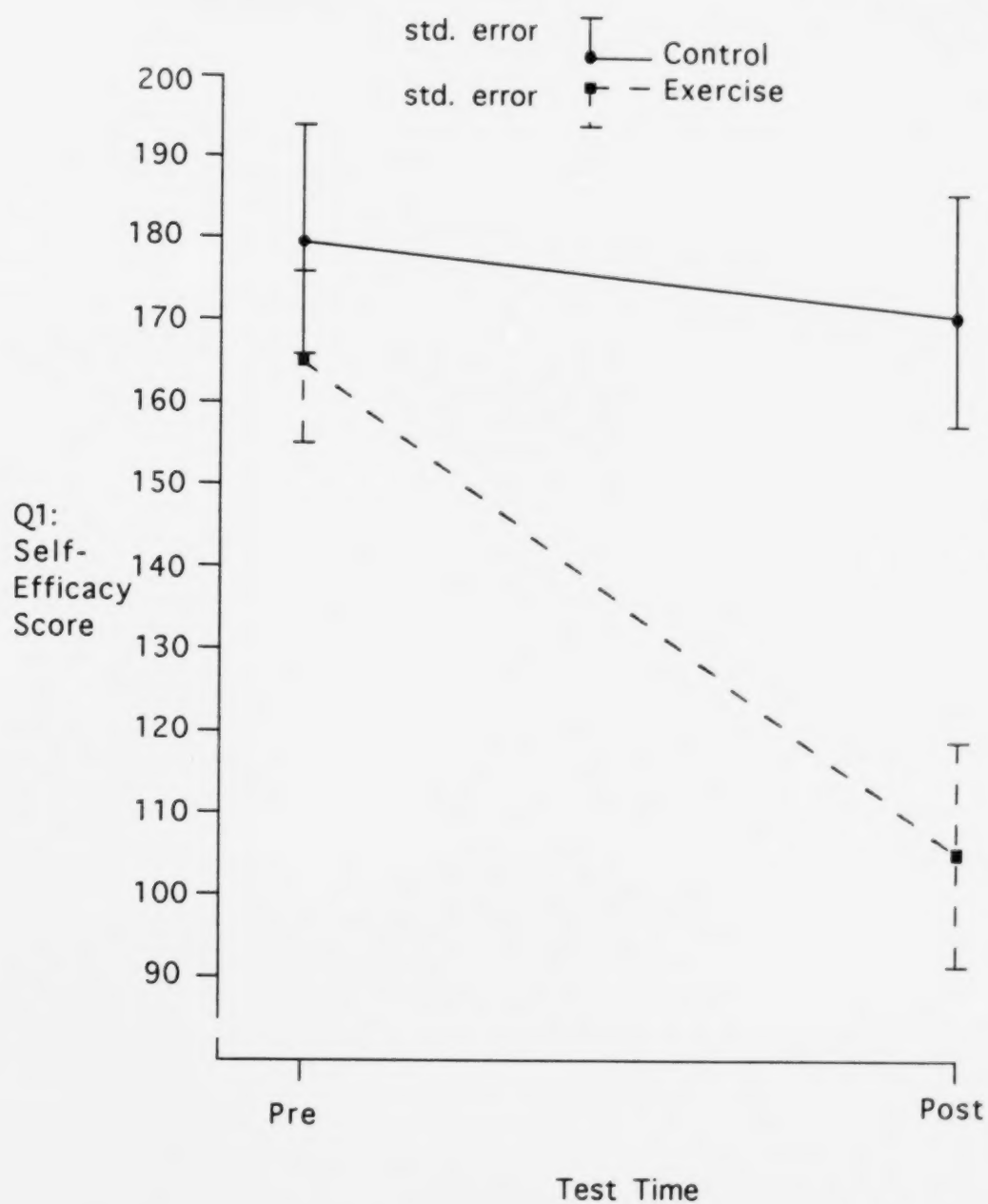


FIGURE 16: The Effect of an 8 Week Program on Self-Efficacy Scores (Q1)

The only activity that was specific to the exercise program followed by the Exercise group was the walking component of the questionnaire. However, the other three components (aerobic dance/exercise, stair-climbing, and lifting) are activities that all subjects were familiar with (Control and Exercise) and that most had engaged in at some time. Thus, they were familiar with the activities listed in questionnaire one. In scoring questionnaire one, greater perceived physical self-efficacy was indicated with a lower number. An improvement in perceived ability to perform a specific task (in this case, walking, aerobic dance/exercise, stair-climbing, and lifting) was indicated by a decrease in self-efficacy score at post-intervention.

The ANOVA revealed a statistically significant difference in physical self-efficacy measures between and within groups ($p < 0.05$). The physical self-efficacy scores for the Exercise group were significantly different from the Control group scores at pre-intervention. When both the Exercise and Control group scores were considered together, there was a significant change in physical self-efficacy over time. And the change in self-efficacy score the Exercise group exhibited over time was significantly different from the change the Control group exhibited over time.

At pre-intervention, the Control group's score was greater than the Exercise group's score by 13.4 (a 7.5% difference). There was a mean difference of 61.3 between the Exercise group mean score at pre-intervention and at post-intervention, representing a decrease in score of 36.8%.

The significant decrease in mean perceived physical self-efficacy score in the Exercise group indicates a substantial increase in the level and strength of this group's belief that they could successfully perform physical activities outlined in the questionnaire successfully. That is, following the exercise intervention, the Exercise group's perceived ability to perform physical tasks was significantly increased (by 36.8%). However, the Exercise group was significantly different from the Control group at pre-intervention for perceived physical self-efficacy. The Control group's score for self-efficacy was 7.5% larger than that of the Exercise group. This difference was not strongly significant (i.e. the F critical was 4.54 and the F observed was 4.99). Nonetheless, this weakens the argument that the exercise program was associated with an improvement in perceived physical self-efficacy in the Exercise group. However, at post-intervention, the significant difference between the Control group change in self-efficacy over time and the Exercise

group change in self-efficacy over time was statistically much stronger (i.e. the F observed was 19.87). From pre- to post-intervention, the Control group's score decreased by 8.5 (a 4.3% difference). Over the intervention period, the Exercise group's score decreased by 61.3 (a 36.8% change). This suggests that the change in the Exercise group score was most responsible for the statistically significant result observed in the repeated measure (B) analysis.

Of the physical and psychological parameters measured, perceived physical self-efficacy was the only one that exhibited a significant difference between the Exercise and Control group at pre-intervention. As has been mentioned, the difference only just reached statistical significance. It is difficult to attribute this difference to a cause or condition. Both groups were composed of self-professed sedentary individuals, the physical tests revealed no significant differences, and the age range in both groups was similar. That the difference between the groups at pre-intervention occurred only in the aerobic dance/exercise and stair-climbing components of self-efficacy suggests that perhaps the Exercise group had greater exposure to these two activities. In recruiting participants, a "sedentary" person was stipulated as someone who had not engaged in a regular physical activity program for more than six months. Perhaps more people in the Exercise group had experience in aerobic dance/exercise prior to participating in the study; perhaps some of the Exercise group participants climbed stairs more than those in the Control group as a part of their daily activity. However, this explanation assumes that there is a relationship between perceived physical self-efficacy and performance of an activity. This argument is not well documented and according to the results from the present study, self-efficacy does not appear to be activity-specific. It appears that the Exercise group was not drawn from the same population as the Control group where physical self-efficacy for aerobic dance/exercise and stair-climbing is concerned.

Regression Analysis

Statistical significance for correlations was accepted at the 0.05 level. Only significant correlations with parameters already discussed are cited (specifically, physiological parameters) in this section; sections to follow contain correlations with self-efficacy as they occurred.

Summary of Results for Significant Correlations with Self-Efficacy

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	PWC ₁₇₀ absolute	5.783	0.308
	PWC ₁₇₀ relative	11.532	0.470
	Pred. V02 max.	6.078	0.303
Control Post-	PWC ₁₇₀ relative	7.233	0.357
Exercise Pre-	PWC ₁₇₀ absolute	5.485	0.255

Significant correlations ($p < 0.05$) between other parameters and self-efficacy were most prevalent in the Control group at pre-intervention. Three significant correlations with self-efficacy emerged in this group: PWC₁₇₀ relative and absolute, and predicted V02 max. The only significant correlation that persisted over time was that between self-efficacy and PWC₁₇₀ relative in the Control group; however, the strength of this correlation appears to have weakened over time. No significant correlations were evident in the Exercise group at post-intervention; it appears that the relationship between self-efficacy and PWC₁₇₀ absolute weakened following exercise intervention.

All of the significant correlations concerning self-efficacy involved predictive measures for maximal oxygen uptake. There were more and stronger correlations between measures of cardiovascular fitness and measures of self-efficacy for cardiovascular activities. This suggests that self-efficacy is activity-specific. However, this relationship did not strengthen following exercise intervention.

a) Q1: Walking

Mean pre- and post-intervention scores for the 'walking' component of the physical self-efficacy questionnaire are presented in Table 14.

The ANOVA revealed a significant difference over time in self-efficacy for walking when both the Exercise and Control group scores were considered

together ($p < 0.05$). However, the Exercise group's score for walking self-efficacy did not change significantly differently from the Control group's score over time. The Control group's mean walking self-efficacy score decreased by 3.4 (an increase of 15.3% in perceived self-efficacy for walking) and the Exercise group's mean walking self-efficacy score decreased by 11.4 (a 44.2% increase in perceived self-efficacy for walking).

TABLE 13
EFFECT OF 8 WEEK PROGRAM ON 'WALKING' SELF-EFFICACY

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2,3 WALKING	MEAN	22	19	26	14
SELF-	std. error	4.2	4.05	5.1	3.9
EFFICACY	$\pm$ sd	16.9	19.0	22.2	17.2

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group scores over time when compared to Control

While not a statistically significant change (unless considered together), the observed increase in self-efficacy for walking in the Exercise group was substantially greater than that in the Control group (i.e. 44.2% vs. 15.3%, respectively). The very large variability exhibited for this parameter may have contributed to the non-significance of the results for walking self-efficacy which showed a 44.2% degree of change in the exercise group (i.e. at post-intervention, the Exercise group exhibited a standard deviation of 17.2 with a mean of 14.4 and a standard error of 3.94). It is interesting to note that walking was the activity the Exercise group engaged in during the exercise intervention. These findings suggest that perceived physical self-efficacy may not be activity-specific. However, these conclusions should be qualified by the fact that the substantial increase in walking self-efficacy for the Exercise group (44.2%) did not reach statistical significance due, partly, to the large variance in scores exhibited.

Regression Analysis

Statistical significance for correlations was accepted at the 0.05 level. Only significant correlations with parameters already discussed are cited (specifically, physiological parameters) in this section; sections to follow contain correlations with walking self-efficacy as other parameters are considered.

Summary of Results for Significant Correlations with Self-Efficacy for Walking

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	PWC ₁₇₀ relative	8.895	0.406
	Predicted V _{O2} max.	5.942	0.298
Control Post-	PWC ₁₇₀ relative	5.217	0.286
Exercise Pre-	PWC ₁₇₀ absolute	4.773	0.230

As with the total self-efficacy score, the only physiological parameters that exhibited a correlation with self-efficacy for walking were those predicting maximal oxygen uptake. The correlation between self-efficacy for walking and PWC₁₇₀ persisted, but weakened, over time in the Control group. The relationship between self-efficacy for walking and PWC₁₇₀ absolute in the Exercise group did not persist to post-intervention. These results suggest a causative relationship between predictive maximal oxygen uptake measures and self-efficacy for walking measures, but that exercise may act to weaken this relationship.

The correlations between measures of cardiovascular fitness and walking self-efficacy suggest that self-efficacy is activity-specific.

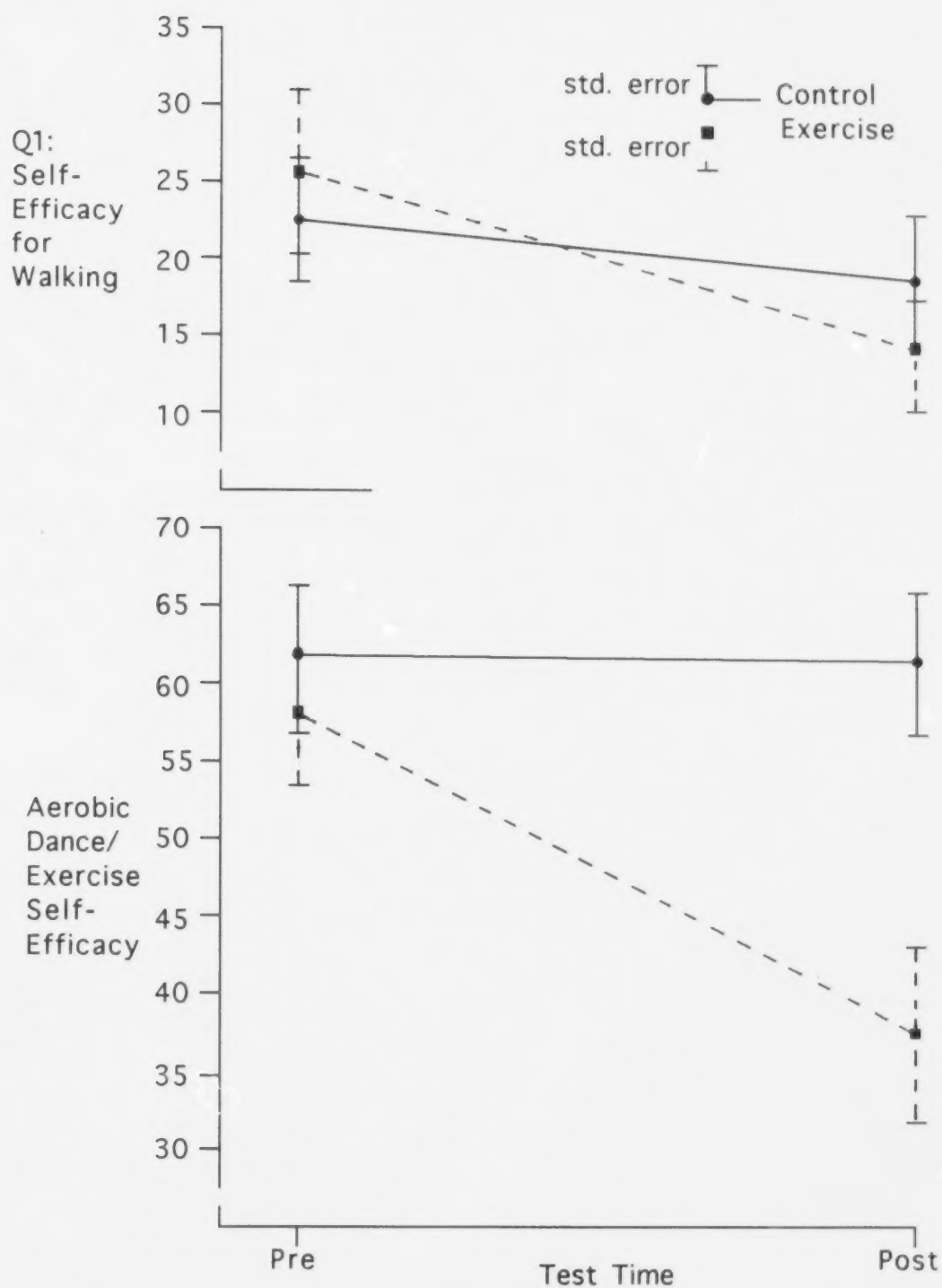


FIGURE 17: The Effect of an 8 Week Program on Self-Efficacy for Walking and Aerobic Dance/Exercise

b) Q1: Aerobic Dance/Exercise

Mean pre- and post-intervention values for 'aerobic dance/exercise self-efficacy' are presented in Table 15.

TABLE 14
EFFECT OF 8 WEEK PROGRAM ON 'AEROBIC DANCE/EXERCISE'
SELF-EFFICACY

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
1,2,3 AER. EX./	MEAN	62	62	58	37
DANCE	std. error	4.72	4.56	5.06	5.17
SELF-EFFICACY	$\pm$ sd	18.9	18.2	22.0	22.5

1 significant difference between Exercise and Control group scores at pre-intervention

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group scores over time when compared to Control

The ANOVA revealed a statistically significant change in perceived self-efficacy for aerobic dance/exercise between and within groups ($p < 0.05$). Specifically, there was a significant difference between groups at pre-intervention, over time (when both groups' scores were considered together), and between groups over time (i.e. the change in the Exercise group scores over time was significantly different from the change in the Control group scores over time). However, the statistically significant difference between the Exercise and Control group scores at pre-intervention was not strongly so; the F observed was 5.03 while the F critical was 4.54.

Self-efficacy for aerobic dance/exercise improved by 36.1% (a mean difference in score of 20.9) in the Exercise group from pre- to post-intervention. There was a mean difference of 24.7 between the Control group and the Exercise group at post-intervention. It is noteworthy that the Control group's

score was nearly identical at pre- and post-intervention (i.e. 61.9 and 61.7, respectively).

The statistically significant increase in perceived self-efficacy for aerobic dance/exercise in the Exercise group following exercise intervention suggests an association between exercise and an improvement in perceived self-efficacy. This relationship is strengthened by the non-significant change in perceived self-efficacy for aerobic dance/exercise in the Control group (0.3%). It is interesting to note that aerobic dance/exercise (as it was understood by the participants in the present study) was not a part of the exercise program to which the Exercise group was exposed. Aerobic dance/exercise is also not an activity that can be done incidentally, as a part of daily living, as are stair-climbing and lifting. This suggests that perceived self-efficacy for a specific activity engaged in (in the present study, walking) may generalize to other activities.

Regression Analysis

Statistical significance for correlations was accepted at the 0.05 level. Only significant correlations with parameters already discussed are cited (specifically, physiological parameters) in this section; sections to follow contain correlations with self-efficacy for aerobic dance/exercise as other parameters are considered.

Summary of Results for Significant Correlations with Self-Efficacy for Aerobic Dance/Exercise

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	PWC ₁₇₀ absolute	9.863	0.431
	PWC ₁₇₀ relative	11.093	0.460
	Predicted V _{O2} max.	7.78	0.357

Only the Control group at pre-intervention exhibited significant correlations with self-efficacy for aerobic dance/exercise; all of these involved predictive measures of maximum oxygen uptake. This suggests that self-efficacy is activity-specific; aerobic dance/exercise involves extensive cardiovascular work.

c) Q 1: Stair-Climbing

Mean pre- and post-intervention scores for 'stair-climbing self-efficacy' are presented in Table 16.

TABLE 15
EFFECT OF 8 WEEK PROGRAM ON 'STAIR-CLIMBING' SELF-EFFICACY

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
1,2,3 STAIR-CLIMBING	MEAN	55.8	53.4	44.7	39.8
	$\pm$ sd	13.4	18.0	16.2	18.7
	std. error	3.35	4.49	3.71	4.28

1 significant difference between Exercise and Control group scores at pre-intervention

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group scores over time when compared to Control

The ANOVA revealed a statistically significant change in perceived self-efficacy for stair-climbing between and within groups ($p < 0.05$). Like the scores for aerobic dance self-efficacy, there was a significant difference in stair-climbing self-efficacy between the groups at pre-intervention. However, unlike that for aerobic dance, the significant difference in stair-climbing self-efficacy between groups at pre-intervention was strongly significant (i.e. F observed was 10.68 while F critical was 4.54). When both groups' scores were considered together, there was a significant difference in stair-climbing self-efficacy over time; the change in the Exercise group's stair-climbing self-efficacy over time was also significantly different than that of the Control group over time.

There was a mean difference of 11.1 between the Control group and the Exercise group at pre-intervention and a mean difference of 23.5 between groups at post-intervention. The Exercise group's mean score decreased by 14.9 (a 33.3% improvement in perceived self-efficacy for stair-climbing) from a mean pre-intervention score of 44.7 to a mean post-intervention score of 29.8.

Conversely, the Control group's score decreased by 2.4 from pre- to post-intervention.

As with the results for perceived self-efficacy in aerobic dance/exercise, the results for stair-climbing self-efficacy indicate an association between exercise intervention and perceived self-efficacy for stair-climbing. These results suggest that following an exercise program which does not include stair-climbing, self-efficacy may have generalized from participation in walking to include stair-climbing. However, many of the Exercise group participants may have experienced a change in their ability to climb stairs as the exercise program progressed. A number of respondents commented upon their increased efficiency in climbing stairs. Stairs are a common feature of everyday life. Hence, the responses to this item may have been based upon the respondents' experience which might weaken the argument that self-efficacy generalizes.

Regression Analysis:

Statistical significance for correlations was accepted at the 0.05 level. Only significant correlations with parameters already discussed are cited (specifically, physiological parameters) in this section; sections to follow contain correlations with self-efficacy for climbing stairs as other parameters are considered.

Summary of Results for Significant Correlations with Self-Efficacy for Climbing Stairs

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	PWC ₁₇₀ relative	5.301	0.290
	Predicted V02 max.	4.917	0.260

As with walking and aerobic dance/exercise self-efficacy, predictive measures of aerobic capacity were the only parameters that correlated significantly with self-efficacy for climbing stairs. This relationship only appeared in the Control group and did not persist over time.

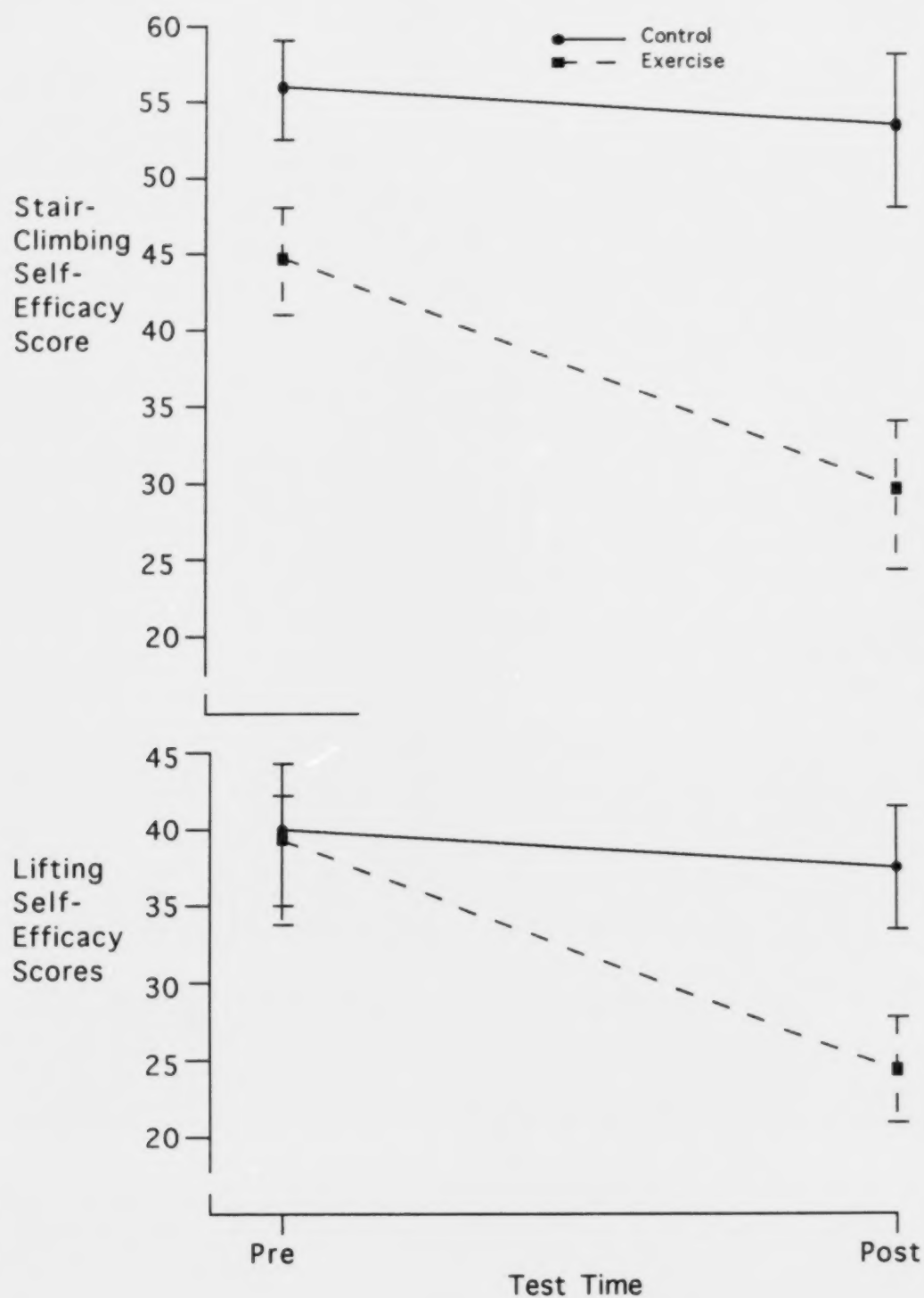


FIGURE 18: The Effect of an 8 Week Program on Self-Efficacy for Climbing Stairs and Lifting Loads

d) Q 1: Lifting

Mean pre- and post-intervention scores for 'lifting' self-efficacy are presented in Table 17.

TABLE 16
EFFECT OF 8 WEEK PROGRAM ON 'LIFTING SELF-EFFICACY'

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2,3 LIFTING SELF- EFFICACY	MEAN	40.0	37.0	38.0	24.0
	std. error	4.7	4.2	4.2	3.7
	$\pm$ sd	18.70	16.9	18.4	16.1

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group scores over time when compared to Control

The ANOVA revealed a statistically significant change between and within groups in perceived self-efficacy for lifting loads ($p < 0.05$). When both groups' scores were considered together, a significant change occurred over time in self-efficacy for lifting weight. And the increase over time in the Exercise group's self-efficacy for lifting weight was significantly different than the increase over time in the Control group's self-efficacy for lifting weight. This suggests a substantial change in the Exercise group's score at post-intervention for perceived self-efficacy for lifting.

The mean difference between the Control group's post-intervention score and the Exercise group's post-intervention score was 13.3. The Exercise group's mean score decreased by 14.1 (a 37.1% increase in perceived self-efficacy for lifting loads) over time. Conversely, the Control group's score decreased by 2.5.

The difference in the Exercise group's pre- to post-intervention results suggests that the exercise intervention was associated with an improvement in perceived self-efficacy for lifting. Like aerobic dance/exercise and stair-climbing, lifting specified loads was not a part of the exercise program. And like

aerobic dance/exercise, lifting specified loads is not a daily activity in most people's lives. This suggests that perceived self-efficacy for physical activities engaged in during the exercise program (i.e. walking, muscular strength and endurance, flexibility) may generalize to perceived self-efficacy for other activities (i.e. aerobic dance/exercise and lifting specified loads).

DISCUSSION and SUMMARY for Physical Self-Efficacy

Following the intervention, the Exercise group improved in physical self-efficacy significantly (by 36.8%) while the Control group did not (4.7%). Other researchers have reported improvements in physical self-efficacy following participation in an exercise program. For example, Ewart et al. (1986) reported that cardiac patients improved physical self-efficacy scores following circuit weight training and volleyball training. Their study revealed that the greatest improvement in self-efficacy corresponded to the specific activities the cardiac patients engaged in (Ewart et al., 1986). Bandura attests that exercise may provide "a series of graded mastery experiences that may enhance self-efficacy" (p. 158, 1977). Other researchers make a stronger case for the connection between exercise intervention and improved self-efficacy. For example, Long (1984 and 1985) and Long and Haney (1988 and 1988) have found that both aerobic conditioning and stress management intervention improved self-efficacy and coping patterns even with no significant improvement in cardiovascular function. Improved self-efficacy and stress management persisted three months after the study; cardiovascular conditioning levels had dropped to original levels (Long, 1984; Long, 1985).

Of the four specific activities assessed in the perceived physical self-efficacy questionnaire, walking was the only one that did not reach statistical significance (although in relative terms, it improved most for the Exercise group). Yet walking was the only specific activity engaged in during the exercise program. An initial (but facile) conclusion might be to suggest that Bandura's argument - that self-efficacy improvements are activity-specific - was not supported by the results of the present study. However, as was mentioned, while changes in self-efficacy for walking did not reach statistical significance, the degree of change was slightly more substantial when compared to aerobic dance/exercise, stair-climbing, and lifting specified loads in the Exercise group (with improvements of 44.2%, 36.1%, 33.3%, and 37.1% respectively) and considerably more substantial than those in the Control group (with

improvements of 15.3%, 0.3%, 4.4%, and 6.1% respectively). As has been mentioned, the large score variance may have made it more difficult to achieve statistical significance for the walking component of perceived physical self-efficacy.

Bearing in mind the substantial change in walking self-efficacy for the Exercise group over time, these results suggest that perceived physical self-efficacy for a specific activity engaged in (in this case, walking) may generalize to other physical activities. When the increase in walking self-efficacy in the Exercise group at post-intervention is considered as a non-significant change alone (without taking into account the degree of change observed), the significant change in the other components of self-efficacy (i.e. aerobic dance/exercise, stair-climbing, and lifting a designated weight) suggest that simply engaging in exercise, regardless of the kind, is associated with significant changes in self-efficacy for other activities. To paraphrase, what the results from the present study suggest do not concur with the findings and conclusions of other researchers such as Bandura (1977 and 1986), Ewart et al. (1986), and Gemma et al. (1988). Results from the present study indicate that participation in an exercise program is associated with improvements in physical self-efficacy for activities other than those engaged in during the program; this suggests that physical self-efficacy is not activity-specific. These findings agree with those of Long (1984 and 1985) and Long and Haney (1988 and 1988). In their research with women participating in an exercise program and a stress-management program, Long and Long and Haney found that self-efficacy improved and persisted three months post-program, even in the absence of a significant improvement in cardiovascular function. The improvement in self-efficacy in their research was not activity-specific.

While the findings from the present study indicate there is an association between participation in an exercise program and an improvement in physical self-efficacy, regression analyses conducted suggest that there is no correlation between self-efficacy and any of the measures of physical fitness conducted in the Exercise group at post-intervention. The regression analysis findings suggest that the exercise program is associated with decreased correlation between predicted measures of aerobic capacity and physical self-efficacy. It is noteworthy that the intervention for the Control group (in the present study, this consisted of no exercise program) was also associated with decreased correlation between self-efficacy and cardiorespiratory fitness measures.

Unexpectedly, there was a substantial number of correlations between the three indicators of aerobic capacity and self-efficacy for activities involving aerobic work in the Control group at pre-intervention. It appears that there is a relationship between self-efficacy (and self-efficacy for walking) and PWC₁₇₀ in the Control group. This strengthens the argument that exercise intervention weakens the relationship between aerobic capacity and self-efficacy. These results also indicate that perhaps participants in the present study became more aware of their physical abilities and limitations following exercise intervention. The intervention period in the present study may have been too short to allow participants to assess their physical abilities more realistically following participation in exercise. To paraphrase, participants may become more knowledgeable, and perhaps more critical of their physical abilities after engaging in an 8 week exercise program. As Sonstroem and Morgan state, participation in an exercise program over a longer period of time (i.e. 15 to 20 weeks) may result in a better correlation between experience and the "accuracy of more specific self-perceptions" (p. 333, 1989).

The results from the present study do not agree with those of Ewart et al. (1986), Gemma et al. (1988), and Sonstroem and Morgan (1989). In their work with cardiac patients, Ewart et al. (1986) and Gemma et al. (1988) found that following participation in an exercise program, the cardiac patients' measures of cardiorespiratory fitness were correlated with perceived physical self-efficacy. From their review of the literature, Sonstroem and Morgan (1989) conclude that measures of physical fitness and measures of self-efficacy probably co-vary among subjects that have participated in an exercise program.

2. Questionnaire 2: Physical Competence:

Questionnaire 2: physical competence refers to regard for the body including abilities and function (Coopersmith, 1967; Epstein, 1973; Fitts, 1965; Messer and Harter, 1986; Secord and Jourard, 1953), and perceived possession of overall physical fitness (Sonstroem and Morgan, 1989). Physical competence is a component of self-concept (or the set of beliefs individuals hold to be true of themselves) (Coopersmith, 1967; Rosenberg, 1979; Rogers, 1950; Sanford and Donovan, 1984). In the present study, Harter's (1982) questionnaire designed to measure physical competence was used. Due to its structured alternative format, the questionnaire assessed the subjects' perceived ability to perform physical activity and assessed the strength and

direction of physical competence with statements such as "very true for me", "moderately true for me", etc. (see Appendix F for Questionnaire 2). The questionnaire was scored such that a larger number denoted greater perceived physical competence. An increase in the score indicates improved perceived physical competence.

The ANOVA revealed a statistically significant increase in competence over time when both groups' scores were considered together ($p < 0.05$). Additionally, the increase in competence found at post-intervention in the Exercise group was significantly greater than the change in competence observed in the Control group at post-intervention ($p < 0.05$). Mean pre- and post-intervention (perceived) physical competence values are presented in Table 18.

TABLE 17
EFFECT OF 8 WEEK PROGRAM ON PHYSICAL COMPETENCE
(higher score indicates greater physical competence)

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2,3 COMP- ETENCE	MEAN	16.4	16.1	15.6	18.6
	±sd	5.2	5.6	3.7	3.5
	std. error	1.30	1.39	0.85	0.80

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group scores over time when compared to Control

The Exercise group's mean pre-intervention score improved by a mean of 3, a 19.2% increase in physical competence in the Exercise group; this change was significantly greater than that observed in the Control group over time ($p < 0.05$). These results suggest that the exercise intervention was associated with increased physical competence.

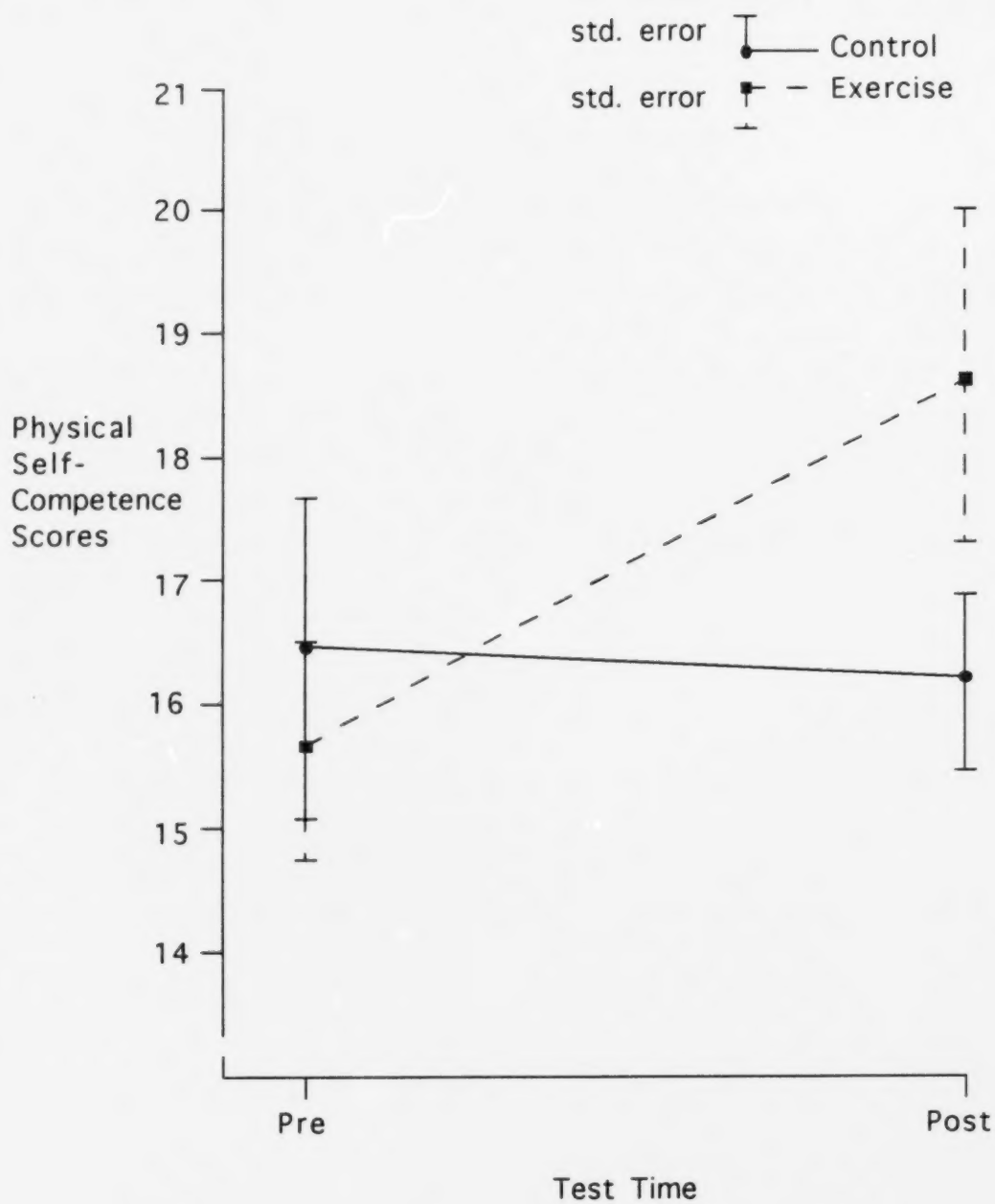


FIGURE 19: The Effect of an 8 Week Program on Physical Competence Scores

Regression Analysis:

Statistical significance for correlations was accepted at the 0.05 level. Only significant correlations with parameters already discussed are cited (specifically, physiological parameters and self-efficacy) in this section; sections to follow contain correlations with physical competence as other parameters are considered.

Summary of Results for Significant Correlations with Physical Competence

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	Combined Grip Strength	24.044	0.632
	Push-Ups	5.22	0.272
Control Post-	Self-Efficacy	5.597	0.286
	Aerobic Dance Self-Efficacy	8.389	0.375
Exercise Pre-	Combined Grip Strength	5.581	0.247
Exercise Post-	Combined Grip Strength	18.98	0.528

An interesting pattern emerged in the regression analysis results for physical competence. Whereas aerobic capacity measures were the only physiological parameters that correlated with physical self-efficacy, muscular strength and endurance measures were the only physiological parameters that correlated with physical competence. However, only the relationship between combined grip strength and physical competence in the Exercise group persisted (and strengthened substantially) over time.

The purported causative relationship between physical self-efficacy and physical competence (Sonstroem and Morgan, 1989) occurred, but only in the Control group. This correlation persisted and strengthened over time; these findings do not support the rationale for the relationship between exercise and self-esteem presented by Sonstroem and Morgan (1989).

The regression analysis results suggest three things: that the exercise intervention was associated with an improved correlation between combined grip strength and perceived physical competence; that the exercise intervention did not improve the correlation between self-efficacy and physical competence; and that there appears to be a general trend toward greater association between muscular strength and endurance elements of physical fitness and perceived physical competence.

DISCUSSION and SUMMARY for Questionnaire 2: Physical Competence

Perceived physical competence increased significantly following exercise intervention in the present study. These results concur with other research on the association between exercise and physical competence; in some of these cases, however, physical competence appeared to be activity-specific. For example, Ewart et al. (1983) found that the competence judgements for walking in postmyocardial infarction patients improved following treadmill testing. Taylor et al. (1985) and Roviario et al. (1984) chronicled similar results with cardiac patients. Research in which physical competence was not activity-specific included Harter (1982) and Marsh et al.'s (1983) study with children, and Marsh and O'Neill (1986), Ryckman et al. (1982), and Safrit et al.'s (1986) work with college students. These researchers and others also found that an improvement in self-competence led to improvements in global self-concept (Ewart et al., 1983; Harter, 1982; Marsh et al., 1983; Marsh and O'Neill, 1986; Roviario et al., 1984; Ryckman et al., 1982; Safrit et al., 1986; and Taylor et al., 1985).

Like Harter (1982), Marsh et al. (1983), Marsh and O'Neill (1986), Ryckman et al. (1982), and Safrit et al. (1986), the results from the present study suggest that an improvement in perceived physical self-competence following exercise intervention is not specific to the activity engaged in. Harter's questionnaire assessing self-competence was used in the present study. This questionnaire measures the respondent's self-competence judgements for general physical activity and games; competence assessments for specific activities such as 'walking' or 'aerobic dance' do not appear. Because measures of self-competence increased significantly following exercise intervention, even though the questionnaire did not assess perceived self-competence for any of the specific activities engaged in during the exercise program, it appears that for previously sedentary women in this study, self-competence is not activity-specific.

While measures of fitness and self-competence improved concomitantly following exercise intervention in the present study, the regression analysis run on the data indicate that only combined grip strength was correlated with perceived physical self-competence in the Exercise group at post-intervention. This suggests two things: that self-competence was not activity-specific in the present study and that changes in physical fitness measures did not cause (or

correlate with) increased physical self-competence. Conversely, Gemma et al. (1988) reported that cardiorespiratory fitness measures correlated with self-competence measures in their study with cardiac patients.

The rationale that competencies generalize from specific self-efficacy (in the present study, for walking) to increased sense of competence for physical activity generally is a fundamental part of Sonstroem and Morgan's model. Both physical self-efficacy and physical competence measures increased in the present study following exercise, but there was no relationship between them. This may have been due to the relatively short duration of the present study; perhaps the participants' perception of their physical competence and efficacy was not realistically assessed following exercise intervention.

There is more research in the literature investigating the relationship between exercise and global self-concept than there is examining the relationship between exercise and components of global self-concept (i.e. physical competence and physical acceptance). Of these, most report an improvement in self-concept following exercise intervention (MacMahon and Gross, 1987; MacMahon and Gross, 1988; Roviato et al., 1984; Hatfield et al., 1985; Hughes, 1984; Trujillo, 1983; Perri and Templer, 1985; Ossip-Klein et al., 1989; Short et al., 1984). Results from the present study agree with these researchers' findings to the extent that the physical self-competence component of self-concept was measured in the present study. However, a number of researchers have not found significant changes in self-concept following exercise intervention (Rainey and Wigtil, 1985; Palmer et al., 1988; Ford et al., 1989). Conditions in two of these studies may have compromised the results; for example, the exercise program was loosely defined and organized in Rainey and Wigtil's study (1985) and the exercise program in Palmer et al.'s study (1988) was inordinately short at only four weeks in duration.

In the present study, no correlation between self-efficacy and self-competence was observed in the Exercise group at post-intervention; improvements in physical fitness, physical self-efficacy, and physical competence following exercise intervention occurred concomitantly but independently. These results concur with those of Harter (1982), Ewart et al. (1983), Taylor et al. (1985), Gemma et al. (1988) and others. However, these results do not concur with those of Hughes (1984), Gemma et al. (1988), and Sonstroem and Morgan (1989).

Only the Control group at post-intervention exhibited a correlation between self-efficacy and self-competence. No research was found in the literature with similar results. That there was a causative relationship that persisted and strengthened over time between self-efficacy and self-competence in the Control group suggests that Sonstroem and Morgan's model and rationale (i.e. that exercise may act as a catalyst to improve self-efficacy, which then mediates an improvement in physical competence) does not apply in the present study. However, it is important to note that two factors may influence the Control group's results: first, with a smaller number of participants (i.e. 16 vs. 19), the strength of the correlation for the Control group changes; and second, large residuals and outlying values evident in the regression analyses may have led to misleading regression lines.

In summary, following exercise participation, the strength of the correlation between combined grip strength and physical competence increased. Self-efficacy did not generalize to self-competence in the present study (i.e. the regression analysis revealed no relationship between self-efficacy and physical competence following exercise), but both self-efficacy and self-competence improved concomitantly with physical fitness following exercise intervention.

3) Questionnaire 3: Physical Acceptance

According to Mahoney and Finch (1976), Rosenberg (1979), Secord and Jourard (1953), and Wylie (1974), physical acceptance is an important part of self-concept. It is a measure of satisfaction with the body and its parts and processes. The questionnaire assessing physical acceptance is based upon Secord and Jourard's Body Cathexis Scale (1953). It measures the subject's assessment of thirty-four (34) physical features and functions (e.g. waist, weight, legs, appetite, body build, physical coordination, muscular strength, etc.; see Appendix G for Questionnaire 3). Strength and direction of physical acceptance of physical features and functions were indicated with a one to five rating (one associated with strong positive feelings, to five associated with strong negative feelings). The questionnaire was scored such that a smaller number indicates greater physical acceptance. An improvement in physical acceptance was designated by a decrease in the physical acceptance score. Mean pre- and post-intervention values for acceptance are presented in Table 19.

TABLE 18
EFFECT OF 8 WEEK PROGRAM ON PHYSICAL ACCEPTANCE
 (higher score indicates lower physical acceptance)

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2,3 ACCEPT- ANCE	MEAN	100.0	98.2	107.0	91.6
	$\pm$ sd	20.0	19.0	13.4	18.3
	std. error	5.00	4.76	3.07	4.21

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group scores over time when compared to Control

The ANOVA revealed a statistically significant difference ($p < 0.05$) between and within treatment groups in mean physical acceptance score. When both the Exercise and Control group scores were considered together, there was a significant improvement in physical acceptance over time. The increase in the Exercise group's physical acceptance score at post-intervention was significantly greater than the change in the Control group's physical acceptance over time ($p < 0.05$). Specifically, the Exercise group exhibited a mean decrease of 15.4 in physical acceptance score (a 14.4% increase in physical acceptance). The Control group's mean physical acceptance score decreased at post-intervention as well, but not statistically significantly (1.8% increase in physical acceptance). It appears that the exercise intervention was associated with a substantial increase in physical acceptance in the Exercise group.

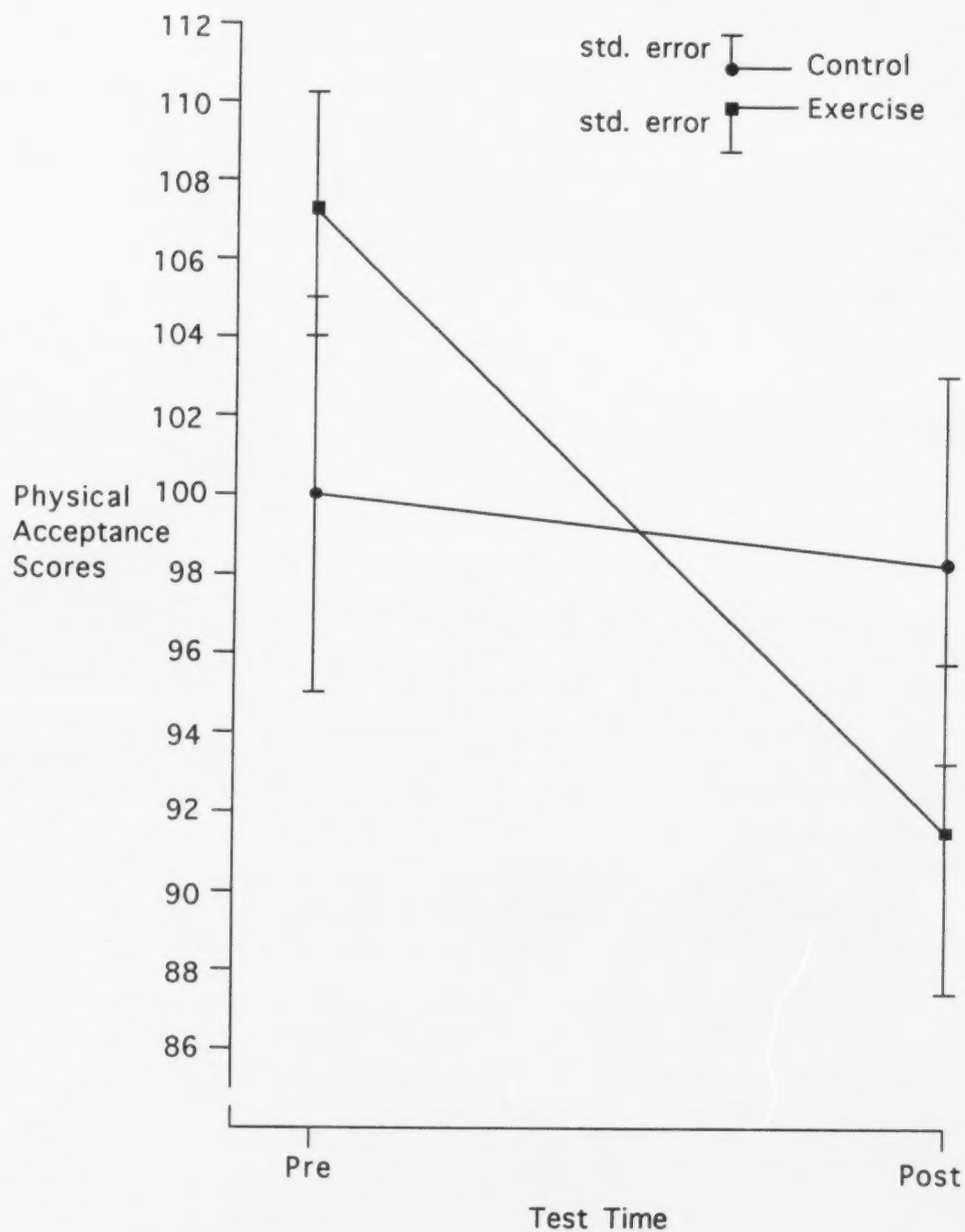


FIGURE 20: The Effect of an 8 Week Program on Physical Acceptance

Regression Analysis:

Statistical significance for correlations was accepted at the 0.05 level. Only significant correlations with parameters already discussed are cited in this section; sections to follow contain correlations with physical acceptance as other parameters are considered (i.e. global self-esteem, locus of control, and hope).

Summary of Results for Significant Correlations with Physical Acceptance

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	Physical Competence	6.85	0.329
Control Post-	Physical Competence	18.855	0.574
Exercise Pre-	PWC ₁₇₀ absolute	9.523	0.373
	PWC ₁₇₀ relative	7.778	0.327

The regression analysis results suggest that the intervention the Control group was exposed to (i.e. no exercise program) was a better indicator of correlation between physical competence and physical acceptance than the exercise intervention. The relationship between physical competence and physical acceptance for the Control group persisted and strengthened over time; this suggests a causative relationship. Residuals at pre-intervention were large, but at post-intervention, residuals in the relationship between physical competence and physical acceptance for the Control group were much smaller.

Only at pre-intervention were there significant correlations for the Exercise group. No correlation was observed between physical competence and physical acceptance for the Exercise group.

Like the results for self-efficacy for the Exercise group, measures of cardiorespiratory fitness appear to be better correlated with physical acceptance, and predominantly at pre-intervention. These results suggest that exercise weakens the relationship between aerobic capacity and physical acceptance. Conversely, combined grip strength (a measure of muscular strength and endurance) was better correlated with physical competence for the Exercise group, and more strongly so at post-intervention. Correlations between psychological parameters have not been observed for the Exercise group. This suggests that the exercise intervention does not influence correlations between self-efficacy, competence, or acceptance. To the contrary, the regression analysis suggests that no exercise intervention may be a better

predictor of correlation between these psychological parameters than exercise intervention.

DISCUSSION and SUMMARY for Questionnaire 3: Physical Acceptance

Results in the present study suggest that the exercise intervention was associated with a significant increase in physical acceptance (14.4% increase) in the Exercise group. Pollock et al. (1984) report similar results; they postulate that the exercise program encouraged physical acceptance through supportive feedback and acceptance of individuals at every fitness level. Pollock et al. (1984), Morgan (1981) and Morgan et al. (1983) also argue that physical self-awareness following physical activity may contribute to physical self-acceptance as well.

Research chronicling the effect of exercise upon physical acceptance of physical features and functions are more scarce than that investigating the effect of exercise upon physical competence. Using only weight loss as an intervention, Rohrbacher (1973) found that boys who lost weight exhibited significantly higher physical acceptance scores following the intervention. In the present study, the Exercise group did not lose significantly more weight than the Control group; this indicates that unlike Rohrbacher's (1973) results, the increase in physical acceptance observed in the previously sedentary women in the present study was probably not due to weight loss.

However, as with the conclusions of Pollock et al. in their research (1984), it is probable that the increased physical acceptance in the present study group may have been due, in part, to positive feedback and encouragement during the exercise program and the acceptance of the group participants at every fitness level. These factors were not assessed in the present study due to the volume of questionnaires given to the participants. However, as Jasnoski et al. (1981), Pollock et al. (1984), and Sonstroem and Morgan (1989) suggest, it would be worthwhile to assess the contribution feedback and the social environment have upon self-perception following exercise.

Other factors implicit in the exercise program may also contribute to increased physical acceptance following exercise intervention. As Pollock et al. (1984), Morgan (1981), and Morgan et al. (1983) hypothesize, physical self-awareness following participation in the exercise program may mediate an

increase in physical acceptance. Sanford and Donovan have found that there is a cyclical relationship between body awareness, physical acceptance, and global self-esteem in their work with women (1984).

As Secord and Jourard (1953), Mahoney and Finch (1976), and Wylie (1974) state, body cathexis or body acceptance is an important component of the personality and is considered a component of self-concept. In their study, Secord and Jourard found that "valuation of the body and the self tend to be commensurate" (p. 346, 1953). They also found that low body cathexis or physical acceptance was associated with greater insecurity, and that women had significantly lower physical acceptance than men (Secord and Jourard, 1953). In their research with women, Sanford and Donovan (1984) have found similar results. Both Secord and Jourard (1953) and Sanford and Donovan (1984) hypothesize that women tend to exhibit greater anxiety about physical acceptance "because of the social importance of the female body" (Secord and Jourard, p. 346, 1953). In her book *Of Woman Born*, Adrienne Rich comments that she does not "know a woman for whom her body is not a continual problem" (p. 292, 1976). And in their study investigating the multidimensional structure of the body esteem scale and differences in scoring related to sex, Franzoi and Shields found three components that differed across sex following principal-components analysis (1984). What this research suggests is that physical acceptance of features and functions plays an important role in women's self-concept (and perhaps a different role than that played in self-concept in men). This concern may be culture-specific.

While there was an association between participation in exercise and physical acceptance in sedentary women in the present study, there was no correlation between any of the physiological or other psychological parameters in the Exercise group at post-intervention. The results of the regression analysis for physical self-efficacy, physical competence, and physical acceptance suggest no causative relationship between these parameters following exercise intervention. While all three increased significantly in the Exercise group post-intervention, none were correlated. Conversely, no significant increase in scores for physical self-efficacy, physical competence, or physical acceptance occurred in the Control group at post-intervention. But correlations between physiological parameters and psychological parameters and between the psychological parameters occurred frequently in the Control group at both pre- and post-intervention. Sonstroem and Morgan's model

(1989) depicting an increase in physical acceptance dependent upon an increase in physical competence, an increase in physical competence dependent upon an increase in physical self-efficacy, and an increase in physical self-efficacy resulting from exercise participation does not appear to apply to the sedentary women of the present study. Instead, results from the regression analysis in the present study indicate that quite the contrary applies: no exercise intervention appears to better predict correlations between PWC₁₇₀ and physical self-efficacy (and self-efficacy for walking), physical self-efficacy and physical competence, and physical competence and physical acceptance at post-intervention.

In summary, the results from the present study suggest that among sedentary women, participation in an exercise program was associated with significantly increased scoring in physical acceptance. Physical acceptance scores, however, were not related to physical self-efficacy or physical competence scores in the Exercise group.

4. Questionnaire 4: Global Self-Esteem

While self-concept refers to a conscious, self-structuring aspect of self-regard, self-esteem is more evaluative (Sonstroem and Morgan, 1989). As Coopersmith defines it, self-esteem is a personal judgement of worthiness (1967), or the degree to which individuals feel positive about themselves (Gergen, 1971). Sonstroem and Morgan (1989) recommended Rosenberg's Self-Esteem Scale (1965) to assess self-esteem because it is "a content-free scale (i.e. independent of situational contexts) assessing general self-worth" (p. 335, 1989). This Self-Esteem Scale uses a four point Likert scale to indicate strength and direction of self-esteem rating. This questionnaire was scored such that a smaller score indicated greater self-esteem. Therefore, a decrease in score indicated an improvement in global self-esteem. Mean pre- and post-intervention values for global self-esteem are presented in Table 20.

TABLE 19
EFFECT OF 8 WEEK PROGRAM ON GLOBAL SELF-ESTEEM
 (higher score indicates lower global self-esteem)

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
GLOBAL	MEAN	18.4	18.2	17.6	16.2
SELF-	$\pm$sd	5.2	5.4	3.8	4.0
ESTEEM	std. error	1.30	1.34	0.87	0.91

The ANOVA did not reveal a statistically significant difference in global self-esteem scores between or within treatments. Although not a statistically significant change, the Exercise group's mean global self-esteem score decreased by 1.4 (a 7.8% increase in global self-esteem). The large variability (as indicated by a standard deviation of 4.0 for the Exercise group's post-intervention mean score of 16.2 and a standard error of 0.91) may have masked true differences where true differences occurred.

Regression Analysis:

Statistical significance for correlations was accepted at the 0.05 level. Only significant correlations with parameters already discussed are cited in this section; sections to follow contain correlations with global self-esteem as other parameters are considered (i.e. locus of control and hope).

Summary of Results for Significant Correlations with Global Self-Esteem

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	Physical Acceptance	13.500	0.491
Exercise Pre-	PWC ₁₇₀ relative	4.920	0.235
	Predicted V02 max.	5.106	0.231

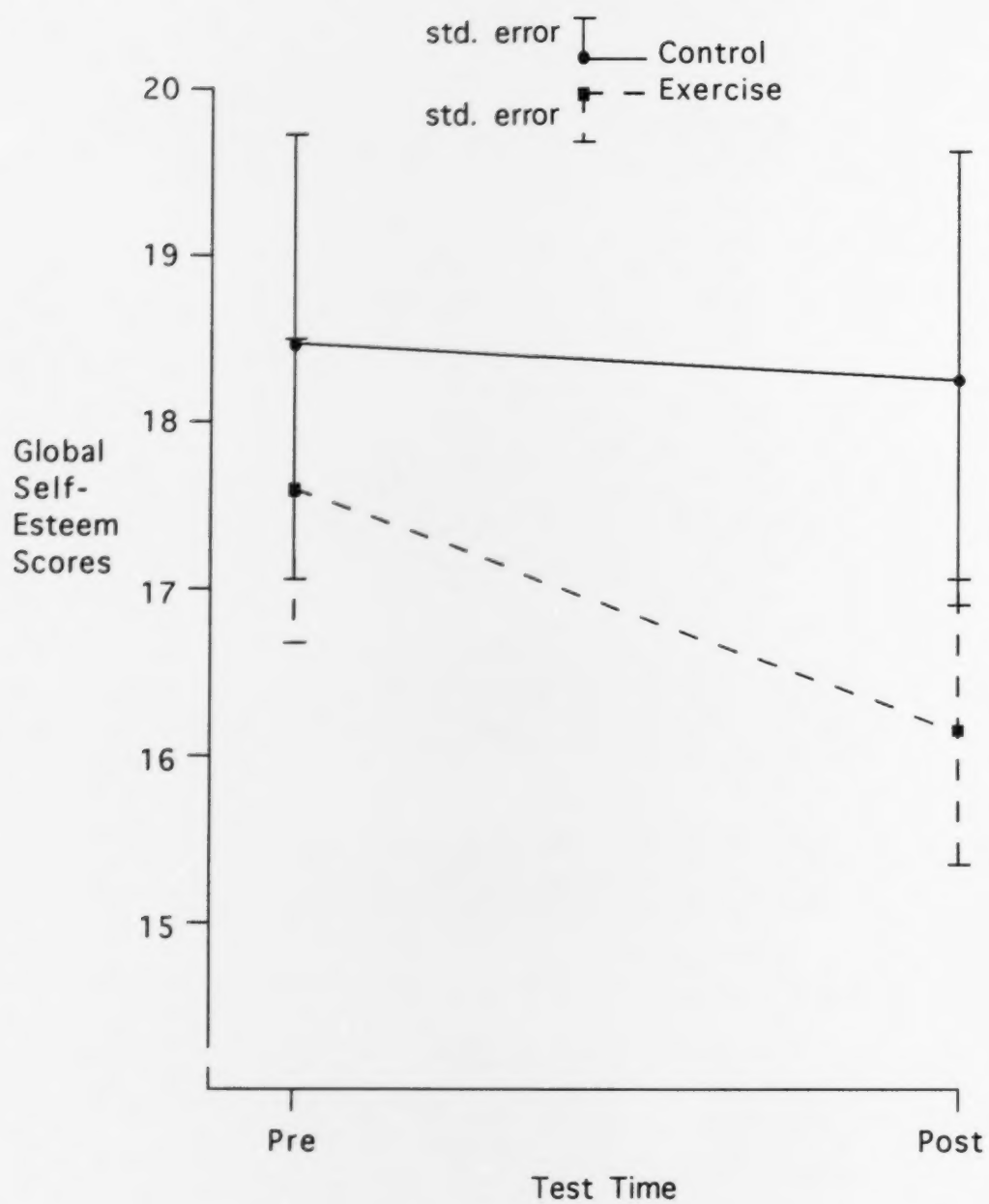


FIGURE 21: The Effect of an 8 Week Program on Global Self-Esteem

As with other psychological variables, no correlations appeared between physiological parameters and global self-esteem or between self-efficacy, competence, or acceptance and self-esteem in the Exercise group at post-intervention. Interestingly, a significant correlation was observed for the Exercise group at pre-intervention between relative PWC₁₇₀ and global self-esteem and between predicted V_{O2}max and global self-esteem (although a weak one). These relationships did not persist to post-intervention. There was a significant correlation between physical acceptance and global self-esteem for the Control group at pre-intervention. This relationship did not persist over time.

SUMMARY for Questionnaire 4: Global Self-Esteem

Results examining the relationship between exercise and global self-esteem in the present study were not statistically significant. The findings from the present study correspond with conclusions from a number of other researchers, including Nagy (1988), Netz (1988), Munson et al. (1985), and Munson (1988). In these studies, no significant differences in self-esteem (among other variables) were found following participation in an exercise program.

Conclusions from research chronicling the relationship between exercise and self-esteem are equivocal. Some researchers, such as Hinkle (1988) report that exercise is beneficial for self-esteem, depression, anxiety, and creative thinking. Similarly, Chastain and Shapiro (1987) and Finocchiaro and Shmitz (1984) found that exercise was associated with improvements in self-esteem and body image in patients with mental disorders, and reductions in depression among depressed and emotionally disturbed adolescents. However, the research exhibiting improvements in self-esteem following exercise cited thus far involved subjects with various degrees of psychological disorder. In more stable populations, the results of research on exercise and self-esteem is equivocal. For example, similar to the results in the present study, Nagy and Frazier (1988), Netz et al. (1988), Munson et al. (1985), and Munson (1988) reported no significant change in self-esteem following exercise intervention.

In the research reporting significant improvements in global self-esteem following exercise intervention, a number of theories for this change arise. According to Fox et al. (1985), self-esteem can be improved with physical

fitness and increased activity levels through improved physical estimation. And Siberstein et al. reported that self-esteem was correlated with overall body esteem in their study with college-age males and females (1988). Yet in the present study, while physical acceptance (physical estimation or body esteem) did improve significantly in the exercise group at post-intervention, no significant change was found in self-esteem and no correlation was evident between physical acceptance and self-esteem. Morgan asserts that exercise may cause a change in self-esteem either by improving self-efficacy and self-concept (through improvement in the components of self-concept: physical competence and physical acceptance), or exercise may be merely associated with changes in these psychological parameters (Morgan, 1985). As has been outlined, Sonstroem and Morgan (1989) hypothesized that a model showing a relationship between exercise and self-esteem could address the issue raised by Morgan in 1985. In the present study, Sonstroem and Morgan's model does not appear to apply; exercise intervention did not result in a change in global self-esteem (although it was associated with improvements in physical self-efficacy, physical acceptance, and physical competence in the exercise group) and none of the physiological or psychological parameters were correlated with global self-esteem at post-intervention.

In their book Women and Self-Esteem, Sanford and Donovan (1984) have found that the specific dynamics in the relationship between physical acceptance (or as they refer to it, body image) and self-esteem are complicated. They state that low self-esteem both follows from a negative body image and that low self-esteem causes a negative body image (Sanford and Donovan, 1984). While it appears that an improvement in physical acceptance should improve self-esteem, thus breaking the cycle described by Sanford and Donovan (1984), (and has been stated, a number of researchers' findings agree with this postulation, notably Fox et al. 1985, and Siberstein et al., 1988) the present study did not find that improvements in physical acceptance (or physical self-efficacy or physical competence) were correlated with self-esteem following exercise, or that exercise was associated with a change in global self-esteem. This may have been due to the short duration of the program. Self-esteem is a firmly entrenched belief about oneself; an 8 week program may not have been long enough to realize a change in this variable. Additionally, a change in self-esteem following participation in an exercise program may occur if the participant values the activity and the results derived from engaging in the

activity (Dickstein, 1977; Harter, 1985; Marsh, 1986; Rosenberg, 1979; Sonstroem and Morgan, 1989; and Watkins and Park, 1972). The valuing of self-components assessed in Sonstroem and Morgan's model may provide insights into the relationship between exercise and self-esteem (Sonstroem and Morgan, 1989).

Written, Qualitative Responses

Three questions were posed on the back of the final questionnaire. Exercise program participants were asked to respond to them after completing the questionnaires during the post-intervention test period. The questions were as follows:

- 1) Part of this questionnaire process is based upon a theory that exercise can improve self-confidence and self-esteem. Do you feel this was true for you?
- 2) What benefits did you feel the exercise program had for you personally?
- 3) Did you feel any change in your sense of 'control' over your body or in your own life attributable to the exercise program we did?

Responses to these questions can be found in Appendix N. The following is a summary of the responses to these questions.

Question #1:

- 12 of 16 indicated an improvement in self-esteem and confidence generally
- 7 of 16 indicated an improvement in self-esteem and confidence specific to exercise
 - 3 of these 7 indicated that the act of doing something about their health and physical condition contributed to self-esteem
 - control over this aspect of their life was cited as a contributor to self-esteem by one respondent
 - 5 of these 7 indicated that improved physical condition and physical competence improved self-esteem (specific reference to muscular strength and endurance)

- 4 indicated that improved body shape/image contributed to greater self-esteem
 - 2 of these referred specifically to positive comments from others about body shape as contributor
 - 1 referred to this as the 'vanity' element re. weight and size
- 1 stated that improved physical condition and body shape together contributed to "feeling better about" herself
- 1 said body image and how body felt generalized to greater self-esteem
- 2 indicated that greater energy and "feeling better about me" contributed to greater self-esteem
- 2 indicated that coping mechanisms/stress management contributed to greater self-esteem
 - 1 referred to physically coping better
- 3 stated that they had high self-esteem to start and therefore the program did not contribute except to physical self-confidence
- 3 mentioned increased optimism
 - 1 indicated increased optimism generally
 - 1 indicated greater optimism re. willpower and discipline

Question #2:

- 1 indicated sense of accomplishment
- 1 indicated capability compared to others
- 4 indicated confidence: "sticking with it" to enact changes, to try other activities; perseverance; accountability to regular exercise
- 4 indicated increased energy; "not so tired at night"
- 6 indicated pride in body image and physical function; stronger physically and mentally; greater endurance generalized to other activities
- 5 indicated benefits of being with others (in same condition)
- 2 indicated stress management; more relaxed
- 3 indicated improved attitude to exercise
- 6 indicated more positive attitude, feeling better and happier, improved mood; improved self-confidence and self-esteem
- 3 indicated physical ability/competence generalized to other activities

Question #3:

- 2 said yes, greater control "for exercise" but not daily life
- 8 indicated exercise program resulted in sense of accomplishment ("doing it oneself"), perseverance, results of effort, greater commitment to exercise
 - 3 said yes, greater control specifically but more over mind that "makes it happen"; "exercise is good for the mind"
- 1 said greater control over what body looks like
- 3 indicated positive physical changes; body image/size
- 5 indicated more positive thinking/attitude; "what the body can do if one takes a positive attitude"
- 2 indicated greater energy

Summary for Written, Qualitative Responses

Although seventy-five percent of respondents indicated that self-esteem improved as a result of participation in the exercise program, the quantitative results did not reflect this. The ambiguity of the results may be due to the use of the terms "self-esteem" and "self-confidence". Unless they are defined, the meaning of these terms can be ambiguous themselves; "self-esteem" and "self-confidence" can mean different things to different people.

Recurring responses in the written, qualitative section included improved body image/shape and physical condition due to the exercise program, greater energy, a more positive attitude, improved coping abilities, greater optimism, and a sense of accomplishment resulting from perseverance. The majority of the respondents indicated that these factors contributed to improved self-regard (stated in many ways; e.g. "feeling better" about oneself, greater self-confidence, greater self-esteem, etc.).

According to the responses, the sense of achievement the participants experienced as a result of taking part in the exercise appeared to be as important as the improvements they experienced in physical fitness and in body composition. This suggests that neither perceived nor actual changes in physical fitness were the only factors associated with improvements in physical competence. Initiating participation and adhering to the exercise program appeared to contribute to a sense of personal competence in the present study.

Sonstroem and Morgan's Model for the Relationship Between Exercise and Self-Esteem: Results From the Present Study

Sonstroem and Morgan have developed a systematic, hierarchical model in which improvement in more activity-specific competency judgements at the base of the model lead to improvements in more generalized self-regard parameters (i.e. self-esteem) at the top of the model (1989). This model is based upon Shavelson et al.'s (1976) multifaceted structure for self-esteem in children. From Shavelson et al.'s model (1967) and the features of their theoretical framework, Sonstroem and Morgan developed hypotheses for the relationship between exercise and self-esteem. These include the following:

- A. Physical fitness is more highly related to self-efficacy than to physical competence, physical acceptance, and global self-esteem.
- B. Physical self-efficacy is more highly related to physical competence than to physical acceptance or global self-esteem.
- C. Physical competence is more highly related to global self-esteem than is physical self-efficacy or physical fitness.

Sonstroem and Morgan, p. 335, 1989.

In the present study, some physical fitness parameters improved significantly following exercise intervention. More specifically, statistically significant changes in physical fitness parameters post-intervention occurred in one element of body composition (i.e. suprailiac skinfold score), in the push-ups and sit-ups element of muscular strength and endurance, and in three elements of cardiovascular function (i.e. maximum blood pressure recorded during bicycle test, power output sustained in final four minutes of PWC170 cycle test, and in predicted V02 maximum). Degree of improvement in physical fitness parameters in the Exercise group are compared to changes in the Control group at post-intervention in the following table:

GROUP	PARAMETER	CHANGE
Exercise	Cardiovascular Function	16.9% increase
*stat. sig. change in Predicted V02 max.		
Control	Cardiovascular Function	2.0% decrease
Exercise	Musc. Strength & Endurance	119.0% increase
*stat. sig. changes in push-ups and sit-ups		
Control	Musc. Strength & Endurance	6.8% increase
Exercise	Flexibility	15.4% increase
Control	Flexibility	6.7% increase
Exercise	Total Body Fat	13.4% decrease
Control	Total Body Fat	6.0% decrease

Concomitantly, following exercise intervention, some of the Exercise group's psychological parameter measures improved statistically significantly greater than those of the Control group. These included the Exercise group's measures of physical self-efficacy, physical competence, and physical acceptance. However, the Exercise group's pre-intervention measure in physical self-efficacy was significantly different than the Control group's pre-intervention measure. Therefore, the statistically significant difference between the Control group's and Exercise group's post-intervention self-efficacy measures is not surprising (although the F-test revealed a much stronger level of significance in the AB measure, at 19.87, versus the Group (A) measure, at 4.99). The improvement in the Exercise group's global self-esteem score over time was not significantly different than the change in that of the Control group over time. This may be due to the relatively short duration of the exercise program; Sonstroem and Morgan indicate that a program of 15 to 20 weeks duration may be necessary to realize a change in "broader traits" such as global self-esteem (1989).

The following table lists a comparison of changes in psychological parameters involved in Sonstroem and Morgan's model over time:

GROUP	PARAMETER	CHANGE
Exercise	*Physical Self-Efficacy	36.8% increase
Control	Physical Self-Efficacy	4.7% increase
Exercise	*Physical Competence	19.2% increase
Control	Physical Competence	1.9% decrease

Exercise	*Physical Acceptance	14.4% increase
Control	Physical Acceptance	1.8% increase
Exercise	Global Self-Esteem	7.8% increase
Control	Global Self-Esteem	0.7% increase

* indicates a significantly greater change in the Exercise group scores over time

In the Exercise group, a pattern of improvement in psychological parameters appears to have emerged. The strongest improvement occurred in physical self-efficacy (36.8%). Physical self-competence improvements decreased by half (to 19.2%). Physical self-acceptance improvement was slightly lower (14.4%), and global self-esteem improvement was half that of physical self-acceptance improvement (at 7.8%). Conversely, psychological parameter changes in the Control group were not directionally consistent or significant.

This pattern of improvement, however, does not indicate relationship between any of the parameters tested post-exercise intervention. According to the regression analyses run in the present study, no correlation exists between physiological or psychological parameters at post-intervention in the Exercise group. These results contradict the hypothesis offered by Sonstroem and Morgan regarding the relationship between exercise and self-esteem. In their rationale and model for the relationship between exercise and self-esteem, Sonstroem and Morgan indicate that physical fitness is more highly related to self-efficacy than to the other parameters, physical self-efficacy is more highly related to physical competence, and physical competence is more highly related to global self-esteem (p. 335, 1989). In the present study, at post exercise intervention, no relationship was evident between measures of physiological fitness and self-efficacy, between self-efficacy and competence, between competence and acceptance, and between acceptance and self-esteem in the Exercise group. These findings contradict those of Gemma et al. In their study of the relationship between physical fitness, self-efficacy, and self-esteem in cardiac patients and healthy adults, Gemma et al. found that self-efficacy was linked with physical fitness ($p < 0.05$ to $p < 0.001$) and that self-efficacy was linked to self-esteem through physical competence ($p < 0.05$ to $p < 0.001$). These results applied to both the exercise and cardiac group (Gemma et al., 1988).

It is possible that a program of longer duration may effect a change in correlations between self-conception measures in Sonstroem and Morgan's model; as Sonstroem and Morgan state, a program of 15 to 20 weeks may result in greater accuracy of specific self-efficacy and competency judgements following experience (1989). In the present study, perhaps the Exercise group experienced some discrepancy in their perception of fitness versus the reality of their physical fitness after participating in the 8 week program. Following another 8 weeks of the program, perhaps the Exercise group's perception of physical fitness and competency would more accurately reflect the reality of their fitness level. Morgan (1981) has suggested that increased body awareness following longer duration of exercise program may mediate increased accuracy of effort perceptions.

The regression analyses run in the present study produced results that contradict the research that posits that correlations exist between physical fitness, self-efficacy, competence, acceptance, and self-esteem. For example, a number of researchers have found that a positive change in self-efficacy can lead to improved self-esteem (Gergen, 1971; Hughes, 1984; Rogers, 1950; Rosenberg, 1979; Sonstroem and Morgan, 1989).

No consensus appears evident in the literature regarding whether perceived physical self-efficacy generalizes to physical competence and then to self-esteem. Atkins et al. (1984) and Holloway et al. (1988) found that increased self-efficacy was associated with increased self-esteem. Some researchers report that improved self-efficacy can increase internal locus of control which is then a mediator for improved self-esteem (Litt, 1988). However, in the present study, while self-efficacy improved significantly in previously-sedentary women following exercise intervention, there was no correlation between self-efficacy and self-esteem. And when considering the relationship between competence and self-esteem, a number of researchers have found that physical competence is one of the components of the general competence dimension of global self-esteem (Coopersmith, 1967, Epstein, 1973, and Harter, 1983 and 1985). But the results from the present study did not find that physical competence was correlated with global self-esteem in sedentary women following exercise. Bandura (1977 and 1982) argues that perceived self-efficacy is specific to the activity the individual has engaged in. Results from the present study suggest the opposite; self-efficacy was greater for activities that

the Exercise group did not engage in (i.e. aerobic dance/exercise, stair-climbing, and lifting designated weights versus walking).

When the relationship between physical self-acceptance and self-esteem is considered, Harter (1985), Messer and Harter (1986), and Sonstroem and Morgan (1989) postulate that perceived physical appearance, an important component of self-acceptance, plays an important role in enhancing self-esteem. As other investigators state, the term 'self-esteem' implies a component of self-acceptance (Gergen, 1971; Rogers, 1950; Rosenberg, 1979; Sonstroem and Morgan, 1989). However, while a significant improvement in self-acceptance occurred in the sedentary women post-exercise intervention in the present study, this was not correlated with global self-esteem. The results from the present study also contradict the findings from Fox et al.'s (1985) study, which indicated that physical estimation was a key factor in the relationship between self-esteem, fitness, and physical activity levels. And unlike the present study's results, Silbertstein et al. (1988) reported that self-efficacy correlated with body esteem and that body esteem, in turn, correlated with global self-esteem.

In their book Women and Self-Esteem, Sanford and Donovan (1984) have found that the specific dynamics in the relationship between physical acceptance (or, as they refer to it, body image) and self-esteem are complex. They state that low self-esteem both follows from a negative body image and that low self-esteem causes a negative body image. While it appears that an improvement in physical acceptance should improve self-esteem, thus breaking the cycle described by Sanford and Donovan (1984). A number of researchers' findings agree with this postulation (Fox et al., 1985, and Silbertstein et al., 1988). However, results from the present study indicate that improvements in physical acceptance were not correlated with global self-esteem following exercise; improvements in global self-esteem did not occur.

The findings from the present study concur with those from a number of studies. As has been mentioned (see "Summary for Questionnaire 4: Global Self-Esteem", p.), results of research investigating the effect of exercise upon self-efficacy, competence, acceptance, and self-esteem are often equivocal when conducted with a stable population. Nagy and Frazier (1988), Netz et al. (1988), Munson et al. (1985), and Munson (1988) reported no significant change in parameters such as self-esteem, body image, trait anxiety, locus of control, well-being, and mood states following exercise intervention. However,

these studies did not examine the effect of exercise upon self-efficacy, competence, or acceptance and no regression analyses were run.

Results from the present study indicate that the Control group exhibited correlations between parameters (both physiological and psychological) in the manner hypothesized by Sonstroem and Morgan, albeit without the significant change in physiological or psychological measures. That the results from the Control group more closely fit the rationale and model hypothesized by Sonstroem and Morgan (1989) weakens the case that exercise is associated with strengthened relationships between physical fitness, self-efficacy, competence, acceptance, and self-esteem. However, results from the present study do indicate that there is an association between exercise and improved physiological measures, physical self-efficacy, physical competence, and physical acceptance in sedentary women. These results agree with the rationale and model outlined by Sonstroem and Morgan with the exception of the association between exercise and improved global self-esteem; this was not observed in the present study.

In summary, the results from the present study indicate that exercise is associated with improved physical fitness, self-efficacy, competence, and acceptance in sedentary women. These changes appear to occur independently; no significant relationship between any of the parameters was observed post exercise intervention.

Sonstroem and Morgan's proposed model and theoretical framework for the relationship between exercise and self-esteem may not apply to the in the present study because its focus may be too narrow. Sonstroem and Morgan's model is based upon the multifaceted model for self-esteem outlined by Shavelson et al. (1976). In his model, Shavelson (1976) depicts self-concept hierarchically, in which components of self-concept (e.g. intellectual/academic self-concept, social self-concept, emotional self-concept, and physical self-concept) make up the multi-faceted global self-concept.

Shavelson et al.'s model (1976) proposes that an improvement in situation-specific self-concept will generalize to an improvement in global self-concept. While they don't disagree with this model, Rosenberg's (1979) and Watkins and Parks' (1972) theory of self-concept emphasizes that individuals do not consider every component of self-concept of equal value. According to these researchers, multiplying self-concept item scores by subjective importance attributed by the subjects' to the item would increase validity and

reliability (Rosenberg, 1979; Watkins and Parks, 1972). In their model and rationale, Sonstroem and Morgan also suggest that measuring the subjective importance participants place upon self-regard components measured may offer greater insight into the relationship between exercise and self-esteem (1989).

In the present study, participants may not confer the same degree of value to each of the four components comprising global self-concept that Shavelson et al. describe (1976). To increase global self-esteem by improving global self-concept, perhaps changes need to occur in other components of self-concept along with physical improvements.

In addition, Shavelson et al.'s model is more comprehensive than that devised by Sonstroem and Morgan; perhaps considering one component listed in Shavelson et al.'s model as a predictor of global self-esteem excludes too many of the elements that compose personality. However, Sonstroem and Morgan's model for exercise and self-esteem may apply in situations where the participant experiences some threat to their physical person, where physical self-concept may emerge as the most crucial in the participant's self-concept in such a situation. This was the case in Gemma et al.'s study (1988), in which physical self-competence, physical self-concept, and global self-esteem improved in cardiac patients (i.e. post-myocardial infarct) following exercise. As Marsh (1986), Messer and Harter (1986), Rosenberg (1979), Sonstroem and Morgan (1989), and Watkins and Parks (1972) assert, it may be critical to assess the importance participants attribute to items considered in the model, including physical self-concept. Perhaps greater insight into the global self-esteem construct and its evolution would be derived by comparing the value participants confer upon competency and self-concept elements in the model to the importance attributed to other elements excluded from Sonstroem and Morgan's model, but included in Shavelson et al.'s model.

As Sonstroem and Morgan suggest, factors within the exercise program itself may contribute to changes in self-perception. The significance and contribution of these factors to the variables measured in the present study was not assessed; these factors include feedback from the instructor and participants, mutuality and relationship with others in the group (social factors), and body awareness (Jasnoski et al., 1981; Morgan, 1981; Morgan et al., 1983; Sonstroem, 1984; and Wicklund, 1975).

It would prove insightful to consider the contribution of social factors in the development and modification of self-perception when examining the relationship between exercise and self-esteem. This was not done in the present study. Self-perceptions, notably self-esteem, are learned, primarily in a social context (Scott, 1992). Consideration of the self as a socially learned phenomena, therefore, would appear to be an integral part in any theory investigating the mechanisms of change in self-esteem following participation in exercise.

Perceived or Actual Changes in Physical Fitness: Which were Associated With Psychological Parameter Improvements?

In the present study, statistically significant improvements in physical fitness in the Exercise group over time occurred in muscular strength and endurance (i.e. push-ups and sit-ups), body composition (i.e. the suprailiac skinfold measure), and cardiorespiratory fitness (i.e. predicted V02max, maximum blood pressure achieved in the test, and power output sustained in the final four minutes of the test). Concomitantly, there was a statistically significant change in self-efficacy (specifically, self-efficacy for aerobic dance/exercise, stair-climbing, and lifting designated weight), physical competence, and physical acceptance in the Exercise group over time. The change observed in self-efficacy in the Exercise group suggests that the Exercise group perceived that there was an improvement in their ability to perform physical activity (specifically, aerobic dance/exercise, stair-climbing, and lifting weights) following exercise intervention. An actual improvement in physical fitness occurred in sit-ups, push-ups, suprailiac skinfold measure, and predicted V02 maximum. Therefore, because an actual change in fitness occurred along with an improvement in self-efficacy score, it is difficult to discern whether the perception of an improvement in physical fitness alone would be associated with improvements in psychological parameters, as Bandura attests (1977 and 1982). However, it is interesting that a significant improvement in walking self-efficacy did not occur in the Exercise group at post-intervention. Walking was the activity engaged in during the exercise program, cardiorespiratory fitness did improve as a result, the participants did not know whether there was a significant change in their fitness (until after the testing),

and no improvement in walking self-efficacy was observed; these factors considered together suggest that an actual change in physical fitness alone is not enough to improve self-efficacy. As Bandura states, the perception of physical fitness is a better determinant of improved self-efficacy than actual changes (1977 and 1982); this appears to be true for the specific activity (i.e. walking) the sedentary women in the present study engaged in. However, other elements of self-efficacy did improve significantly following exercise intervention. Self-efficacy for aerobic dance, climbing stairs, and lifting a designated weight, along with general self-efficacy (a total score composed of the four components) improved significantly, even though the Exercise group did not participate in these activities in an organized way. The Exercise group was not informed of any changes in their physical fitness prior to the testing period. This finding suggests two things for sedentary women: that self-efficacy is not activity-specific (contrary to Bandura's findings), and that perception of physical fitness is not always a determinant of self-efficacy (also contrary to Bandura's findings). It is important to mention that no tests were conducted assessing the participants' perception of their personal physical fitness in the present study. Hence, the conclusions drawn should be considered indications only.

According to Bandura, if an individual improves their fitness level but is not aware of it, self-efficacy will not change (1977 and 1982). This theory is corroborated in a number of studies. Finocchiaro and Shmitz (1984), Netz et al. (1988), MacMahon and Gross (1988), and Hatfield et al. (1985) all found that psychological benefits were associated with physical activity but no change in physical fitness. Conversely, Long (1984 and 1988) found that an improvement in self-efficacy and a decrease in anxiety levels were associated with significant improvements in aerobic fitness following aerobic conditioning.

It is not clear whether improved psychological parameters are based upon improved physical fitness (and dependent upon the subject's conscious awareness of this improvement) or whether improved psychological parameters are based upon perceived mastery irrespective of actual fitness gains (Jasnoski et al., 1981; Bandura, 1977 and 1982; and Beck et al., 1979). Conclusions regarding the role of perceived versus actual physical fitness changes as mediator of change in psychological parameters are no clearer in the present study, because both physical fitness and perceived physical self-efficacy improved. Other research sheds more light on this relationship. For example,

Abadie found that an inverse relationship exists between perceived physical fitness and actual physical fitness when the influence of actual physical fitness is removed (1988). From this, Abadie concludes that trait anxiety is better correlated with an individual's self-perception of physical fitness than with actual physical fitness (1988).

As in the present study, Fox et al. (1985) found that improved physical fitness levels following increased physical activity were associated with an improved physical estimation. However, unlike the present study, Fox et al. (1985) observed an improvement in self-esteem following exercise intervention.

As is evident, conclusions drawn from a literature review of studies chronicling the necessity of physical fitness improvement versus perceived physical fitness in psychological changes are ambiguous. To address this issue, more research needs to be done controlling the exercise program such that improvements in physical fitness in one group are negligible and improvements in physical fitness in another are significant. Assessment of the individual's perceived physical fitness and of other psychological variables might then reveal systematic results.

5. Questionnaire 5: Locus of Control

Locus of control refers to the degree to which individuals attribute outcome to action as external to themselves (hence called external locus of control) or as within their sphere of control or power (called internal locus of control) (Robinson and Shaver, 1973). James' Locus of Control Scale (1957) was used to assess this parameter. Strength and direction of locus of control was determined with a four-point Likert scale (rated from strongly agree to strongly disagree). According to the scoring done, a larger score indicates greater internal locus of control. An improvement in internal locus of control was suggested by an increase in locus of control score. Mean pre- and post-intervention values for locus of control are presented in Table 21.

TABLE 20
EFFECT OF 8 WEEK PROGRAM ON LOCUS OF CONTROL
 higher score indicates greater internal locus of control

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
LOCUS OF CONTROL	MEAN	31.3	30.8	29.4	30.7
	$\pm$ sd	3.5	3.4	2.6	3.4
	std.error	0.86	0.84	0.60	0.77

No statistically significant changes in locus of control were indicated from the ANOVA. There was a negligible decrease in internal locus of control in the Control group following intervention. From a mean pre-intervention score of 31.2, the Control group's mean internal locus of control decreased by 0.5 (a 1.6% decrease in internal locus of control) to a mean post-intervention internal locus of control score of 30.7. Conversely, the mean internal locus of control score in the Exercise group increased following exercise intervention, but not significantly so. From a mean pre-intervention locus of control score of 29.4, the Exercise group's internal locus of control increased by 1.3 (a 4.5% increase in internal locus of control) to a mean post-intervention locus of control score of 30.7.

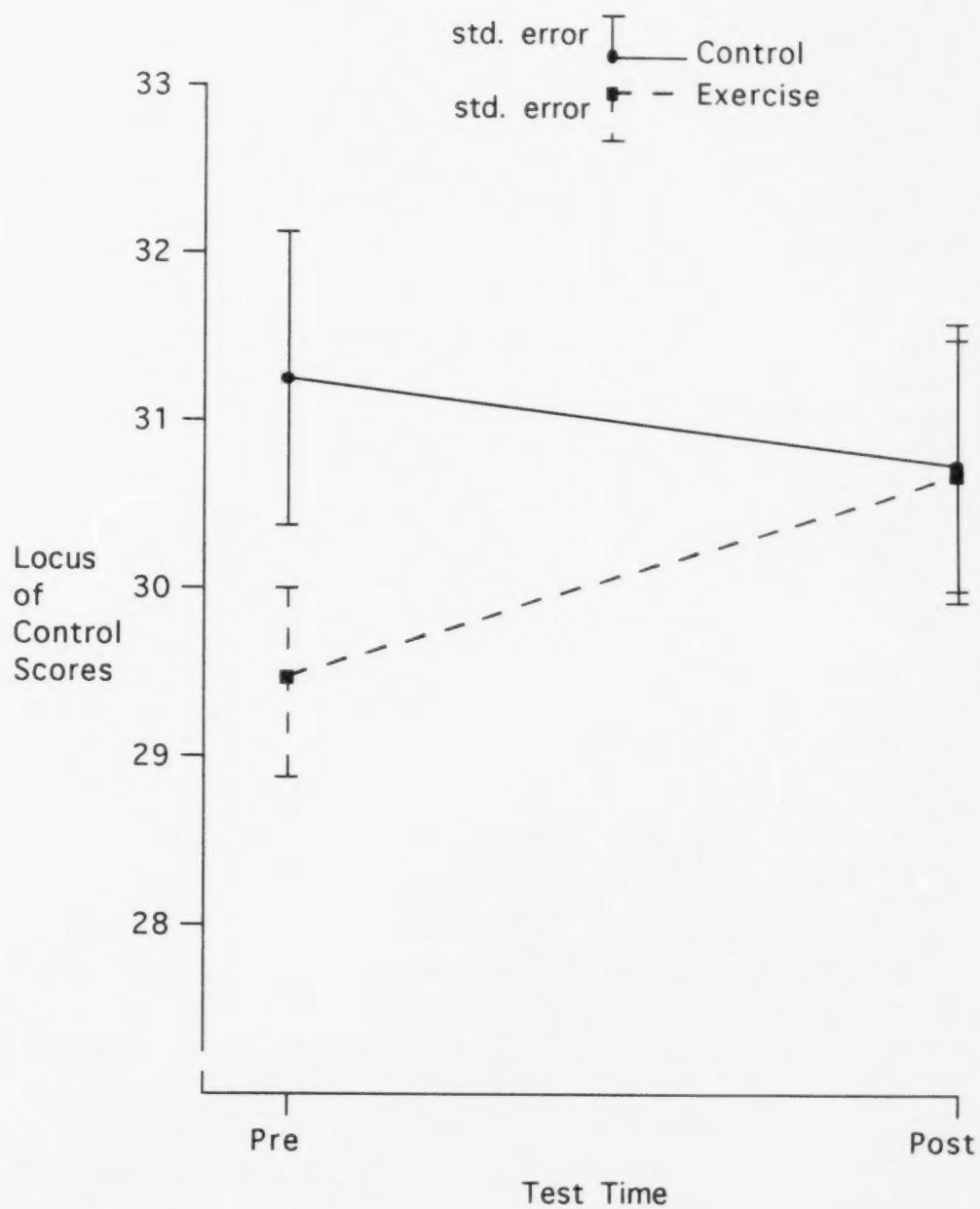


FIGURE 22: The Effect of an 8 Week Program on Locus of Control

Regression Analysis:

Statistical significance for correlations were accepted at the 0.05 level. Only significant correlations with parameters already discussed are cited in this section; sections to follow contain correlations with locus of control as other parameters are considered (i.e. hope).

Summary of Results for Significant Correlations with Locus of Control

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	Self-Efficacy	9.845	0.413
	Walking Self-Efficacy	12.402	0.470
	Physical Acceptance	4.894	0.259
Control Post-	Combined Grip Strength	4.716	0.252
	Self-Efficacy	9.400	0.402
	Walking Self-Efficacy	14.426	0.508
	Stair-Climbing Self-Efficacy	7.945	0.508
Exercise Pre-	Combined Grip Strength	6.533	0.278
Exercise Post-	Aerobic Dance Self-Efficacy	4.512	0.210

A number of correlations with locus of control persisted from pre- to post-intervention in the Control group; self-efficacy and walking self-efficacy. The correlation with walking self-efficacy strengthened, although the scattergram (see Appendix CC) revealed clumping of the values which may have affected the regression line. It is interesting that the correlation between locus of control and physical acceptance did not persist over time. Combined grip strength and stair-climbing self-efficacy correlations with locus of control appeared at post-intervention.

Conversely, only a correlation between locus of control and combined grip strength appeared in the Exercise group at pre-intervention, and this correlation did not persist to post-intervention. At post-intervention, a correlation between locus of control and self-efficacy for aerobic dance appeared, but this was a very weak relationship. Evidently, the exercise intervention was not associated with a relationship between locus of control and other parameters. The significant relationships observed in the Control group suggest that no activity is a better predictor of relationship between locus of control and self-efficacy and walking self-efficacy.

DISCUSSION and SUMMARY for Questionnaire 5: Locus of Control

There are few studies in the literature addressing the relationship between exercise and locus of control. Of the research unearthed in the literature review for this study, the conclusions are ambiguous. For example, in their study with pulmonary disease patients, Kaplan et al. (1984) found no clear association between an increase in perceived efficacy for walking and an increase in generalized health locus of control measures following a three-month walking program. However, they did find that subjects expressed increased perceived efficacy for exercise behaviours similar to walking (Kaplan et al., 1984). These results corroborate Bandura's argument that perceived physical efficacy is activity-specific (1977 and 1982), but does not clarify the role exercise may play in locus of control change. Conversely, Perri and Templer (1985) found that a 14 week exercise program significantly increased self-concept and perceived locus of control in older adults. Whether these psychological variables changed concomitantly or as a result in the change in the other is unknown.

In some studies, locus of control appears to be similar to (and sometimes indistinguishable from) perceived self-efficacy (e.g., Kaplan et al., 1984). In his studies with pain tolerance, Litt (1988) clarifies the distinction between self-efficacy and locus of control. Litt (1988) makes a case for perceived control and self-efficacy as cognitive mediators of pain tolerance. He asserts that self-efficacy is separable from locus of control, and that self-efficacy expectations can mediate the "...desirability of providing control" (Litt, p. 149, 1988).

As a parameter that refers to the degree to which individuals attribute success or failure to internal or external factors, it would appear likely that locus of control and self-esteem should be linked. As Seligman (1975) has found, an extreme shift to an external locus of control orientation leads to "learned helplessness." Sanford and Donovan (1984) have found that a sense of control, personal power, or responsibility (internal locus of control) is essential to self-esteem. However, as with other psychological variables, Sanford and Donovan find that the relationship between locus of control and self-esteem appears to be cyclical. That is, high self-esteem promotes internal locus of control while increased internal locus of control contributes to high self-esteem. Other researchers find a more unidirectional relationship between locus of control and self-esteem. In their review of self-concept and self-esteem theory

and research literature, Weinhold and Hilferty (1983) conclude that locus of control is a necessary component for developing and maintaining self-esteem. This hypothesis renders locus of control an important precursor for self-esteem but does not clarify the organization of this relationship. In Weinhold and Hilferty's review (1983), it is not clear whether increased internal locus of control improves self-esteem by first improving self-concept, whether increased self-concept precedes and causes an improvement in internal locus of control (leading to increased self-esteem), or whether locus of control and self-concept change independently of one another.

The results from the present study contradict these findings. More specifically, no significant change occurred in locus of control following exercise intervention. The regression analysis revealed a correlation between locus of control, self-efficacy and two of the self-efficacy components (i.e. walking and stair-climbing) in the Control group at post-intervention. At post-intervention, there was also a correlation between aerobic dance self-efficacy and locus of control in the Exercise group.

While some studies have chronicled an improvement in locus of control that affects self-esteem, this did not occur in the present study. Locus of control may improve self-esteem by generalizing feelings of self-efficacy and self-competence, but this did not hold true for the present study; perhaps locus of control is linked to self-esteem through other elements of self-concept (i.e. intellectual, emotional, or social; Shavelson et al., 1967).

In their work with battered women, Walker and NiCarthy (1982) found that body awareness exercises incorporating physical activity was one of the most effective therapies in changing "learned helpless" orientations to a greater sense of empowerment and control. They reported that self-esteem tended to subsequently improve. In their work, exercise may provide a series of graded mastery experiences which may increase self-efficacy (Bandura et al., 1982), then self-competence. Exercise may move the individual from a passive to an active cognitive framework (literally as well as figuratively). The participant may experience control over one aspect of their life (i.e. their exercise program) which may generalize to greater perceived control over physical function and features, which may then generalize to greater perceived control over other aspects of the participants life. However, the present study did not reveal a significant change in locus of control and no relationship was evident between locus of control and self-esteem.

6. Questionnaire 6: Hope

Hope has been defined as a state of mind (Obayuwana and Carter, 1982). Researchers attribute strength of hope in individuals to factors in the environment, both internal and external. Hope scales developed to measure degree of hope in individuals reflect the components of hope the researcher feels best represent that state of mind. In the present study, Herth's Hope Scale was used to assess hope. It is a 29 item questionnaire scored with a four-point Likert scale (ranging from strongly agree to strongly disagree). The Herth Hope Scale correlates well with level of coping (measured with the Jalowiec Coping Scale). Three categories of questions comprise the Herth Hope Scale: Factor 1: Action-Oriented Positive Expectancy; Factor 2: Mutuality or Relationship with Others, and Sense of Personal Competence; and Factor 3: Temporality of Present Situation with Future Orientation (Herth, 1988). The results outlining the effects of the treatment intervention upon these factors will be discussed under designated categories. Questionnaire 6 was scored such that a smaller score denoted a higher hope measure. Therefore, a decrease in hope score suggests an improved hope measure. Mean pre- and post-intervention values for hope and its three constituent factors (as outlined by Herth's Hope Scale, 1989) are presented in Table 22.

TABLE 21
EFFECT OF 8 WEEK PROGRAM ON HOPE
 (higher score indicates lower hope measure)

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
2,3 HOPE	MEAN	51.4	51.1	49.2	44.0
	<u>±sd</u>	13.2	11.9	9.7	11.3
	std. error	3.30	2.97	2.24	2.58
FACTOR					
1	MEAN	13.6	13.7	13.7	12.0
	<u>±sd</u>	3.2	3.2	3.0	3.4
	std. error	0.81	0.80	0.68	0.77
2,3					
FACTOR					
2	MEAN	21.4	21.9	20.7	18.3
	<u>±sd</u>	5.2	5.2	4.1	4.6
	std. error	1.29	1.29	0.94	1.05
2,3					
FACTOR					
3	MEAN	17.2	17.1	16.5	15.0
	<u>±sd</u>	4.3	4.9	3.5	4.2
	std. error	1.08	1.12	0.80	0.96

2 significant change over time when both groups' scores were considered together

3 significantly greater change in Exercise group scores over time when compared to Control

According to the ANOVA, there was a statistically significant change in hope measure over time when both groups were considered together ($p < 0.05$). And the improvement in the score for hope in the Exercise group was significantly greater than the improvement in the Control group over time ($p < 0.05$). The Exercise group's mean hope score decreased by 5.1 (a 10.4% improvement in hope measure) from a mean pre-intervention hope score of 49.2 to a mean post-intervention hope score of 44.1.

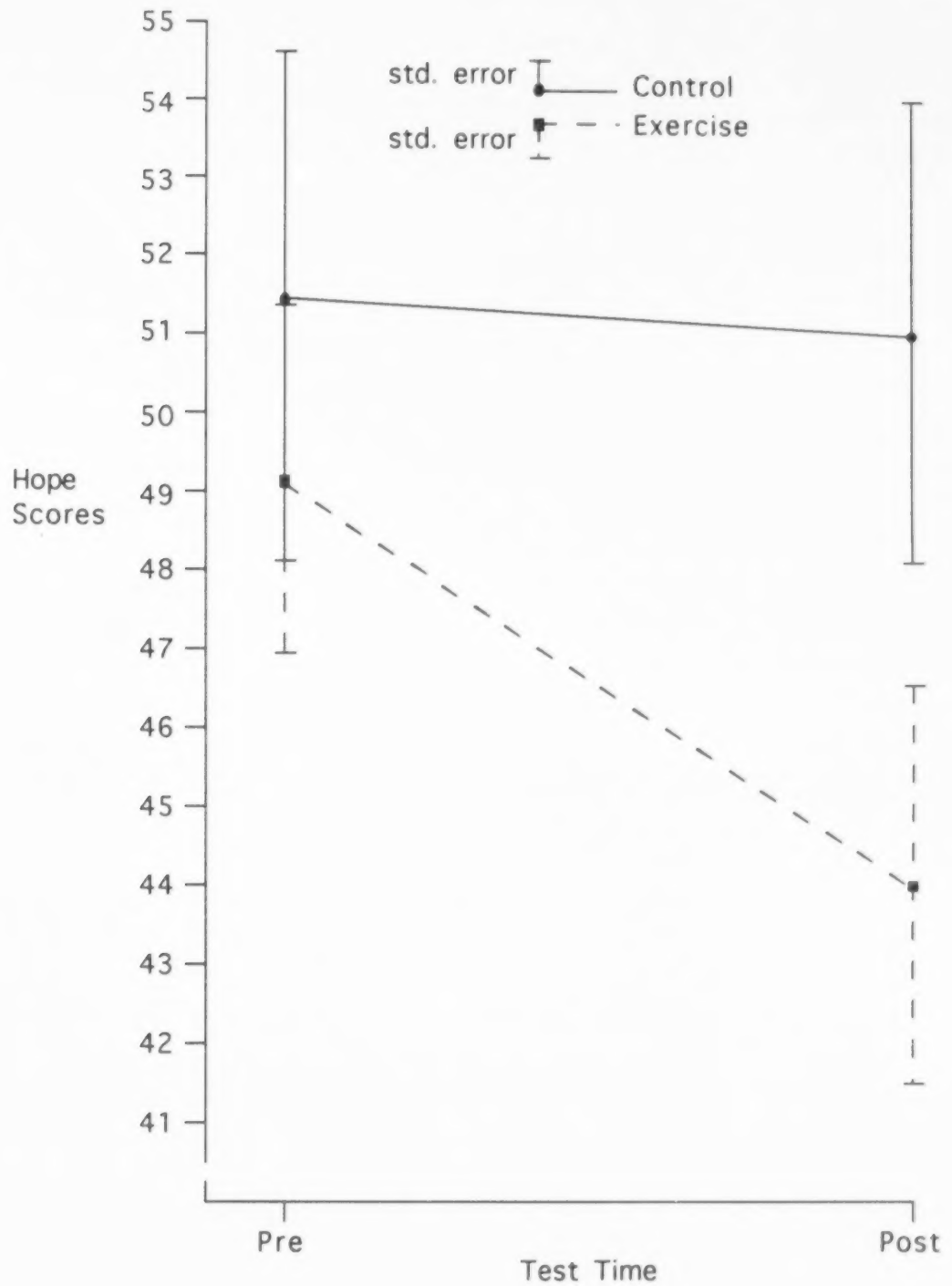


FIGURE 23: The Effect of an 8 Week Program on Hope

The Control group's mean hope score decreased as well, but by substantially less. More specifically, the Control group's mean hope score increased by 0.375 (a 0.7% improvement in hope measure) from a mean pre-intervention hope score of 51.4 to a mean post-intervention hope score of 51.1. These results suggest an improvement in hope measure may be associated with the exercise intervention in the Exercise group.

Regression Analysis

Statistical significance for correlations was accepted at the 0.05 level.

Summary of Results for Significant Correlations with Hope

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	Physical Self-Acceptance	6.477	0.316
	Global Self-Esteem	20.599	0.595
Control Post-	Combined Grip Strength	4.900	0.259
	Global Self-Esteem	33.206	0.703
Exercise Pre-	Global Self-Esteem	27.796	0.620
Exercise Post-	Self-Efficacy	4.271	0.201
	Stair-Climbing Self-Efficacy	6.503	0.277
	Global Self-Esteem	23.021	0.575

The relationship between physical acceptance and hope observed in the Control group at pre-intervention did not persist over time. At post-intervention, a correlation between combined grip strength and hope appeared in the Control group, but this was not a strong relationship. Three outlying residuals in the pre-intervention correlation between hope and physical acceptance in the Control group may tend to affect the regression line to an inordinate degree. One or two outlying residual scores have also been instrumental in creating a regression line from essentially clumped data in the correlation between combined grip strength and hope at post-intervention in the Control group.

At post-intervention, a correlation between hope and self-efficacy and self-efficacy for stair-climbing appeared in the Exercise group. However, neither of these relationships were strong. The scattergram reveals some clumping in the scores for stair-climbing self-efficacy and hope, and that one outlier appears to have flattened the regression line somewhat.

A most interesting pattern emerged in the correlations with hope in all groups and over time; global self-esteem and hope were strongly correlated. For example, the two variables accounted for 60 to 70 percent of the variability observed. This relationship did not appear to be affected by the exercise intervention. It persisted over time for both groups consistently. However, when looking at the scattergrams, notably for the Exercise group at post-intervention, the scores appear to be closer to the regression line than the scores at pre-intervention.

a) Factor 1: Action-Oriented Positive Expectancy

Questions on the Herth Hope Scale designated as Action-Oriented Positive Expectancy include ones like "I know my life has meaning," "I lack belief in my ability to bring about change" (reverse scoring), and others. As with the total hope score, statistically significant improvements in hope were evident when both groups' scores were considered together, and the Exercise group exhibited a significantly greater improvement in hope Factor 1 score over time ($p < 0.05$). The Control group's mean Factor 1 score increased by 0.06 (a 0.5% decrease in action-oriented positive expectancy), from a mean pre-intervention Factor 1 score of 13.6 to a mean post-intervention F1 score of 13.7. Conversely, the Exercise group's mean Factor 1 score decreased by 1.7 (a 12.3% increase in action-oriented positive expectancy) from a mean pre-intervention score of 13.7 to a mean post-intervention Factor 1 score of 12. In the present study, the exercise intervention appears to be associated with an improvement in action-oriented positive expectancy.

It is difficult to interpret these results. A number of the eight items that comprise Factor 1: Action-oriented positive expectancy allude to an event or events that posed a threat to the individual and the individual's response to that threat (e.g. "I keep going even in the midst of hurting"). Other items are more neutral and generalizable. It is difficult to interpret the response to these items in a population with no known, specific threat involved. From personal correspondence with a number of participants, it appears that some respondents assumed the situation referred to in these items might be related to stress in their own life and answered accordingly.

Regression Analysis

Statistical significance for correlations was accepted at the 0.05 level.

Summary of Results for Significant Correlations with Hope: Factor 1

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	Global Self-Esteem	8.927	0.389
Control Post-	Global Self-Esteem	15.102	0.519
Exercise Pre-	Global Self-Esteem	24.900	0.594
Exercise Post-	Global Self-Esteem	11.332	0.400

It is interesting that the statistically significant ($p < 0.05$) correlations involving hope Factor 1 that occurred in both groups pre- and post-intervention also involved self-esteem. The very strong correlation observed between hope Factor 1 and global self-esteem in the Exercise group at pre-intervention (i.e. the two variables accounted for 60% of the variability observed) weakened considerably following the exercise intervention. This suggests that following exercise, global self-esteem and action-oriented positive expectancy were not as strongly related. This is corroborated by the scattergram; it reveals post-intervention hope Factor 1/self-esteem scores for the Exercise group that are much more scattered and less linear than at pre-intervention.

Conversely, for the Control group, the correlation between self-esteem and hope Factor 1 appears to have become stronger over time. At pre-intervention, the scores are quite scattered and not particularly linear in their alignment; at post-intervention, the hope Factor 1/self-esteem scores show a slightly more linear alignment with a bit of clumping. This is further evidence that the exercise intervention was associated with decreased relationship between global self-esteem and hope: action-oriented positive expectancy.

One of the reasons for the decrease in relationship between hope Factor 1 and global self-esteem in the Exercise group over time may be the nature of the questions in hope Factor 1. A number of the statements refer to a threatening situation the respondent was presumably facing. The results may reflect the fact that the population chosen for the present study was not faced with a known threat. However, it is difficult to explain the reason for the improved relationship between hope: action-oriented positive expectancy in the Control group over time.

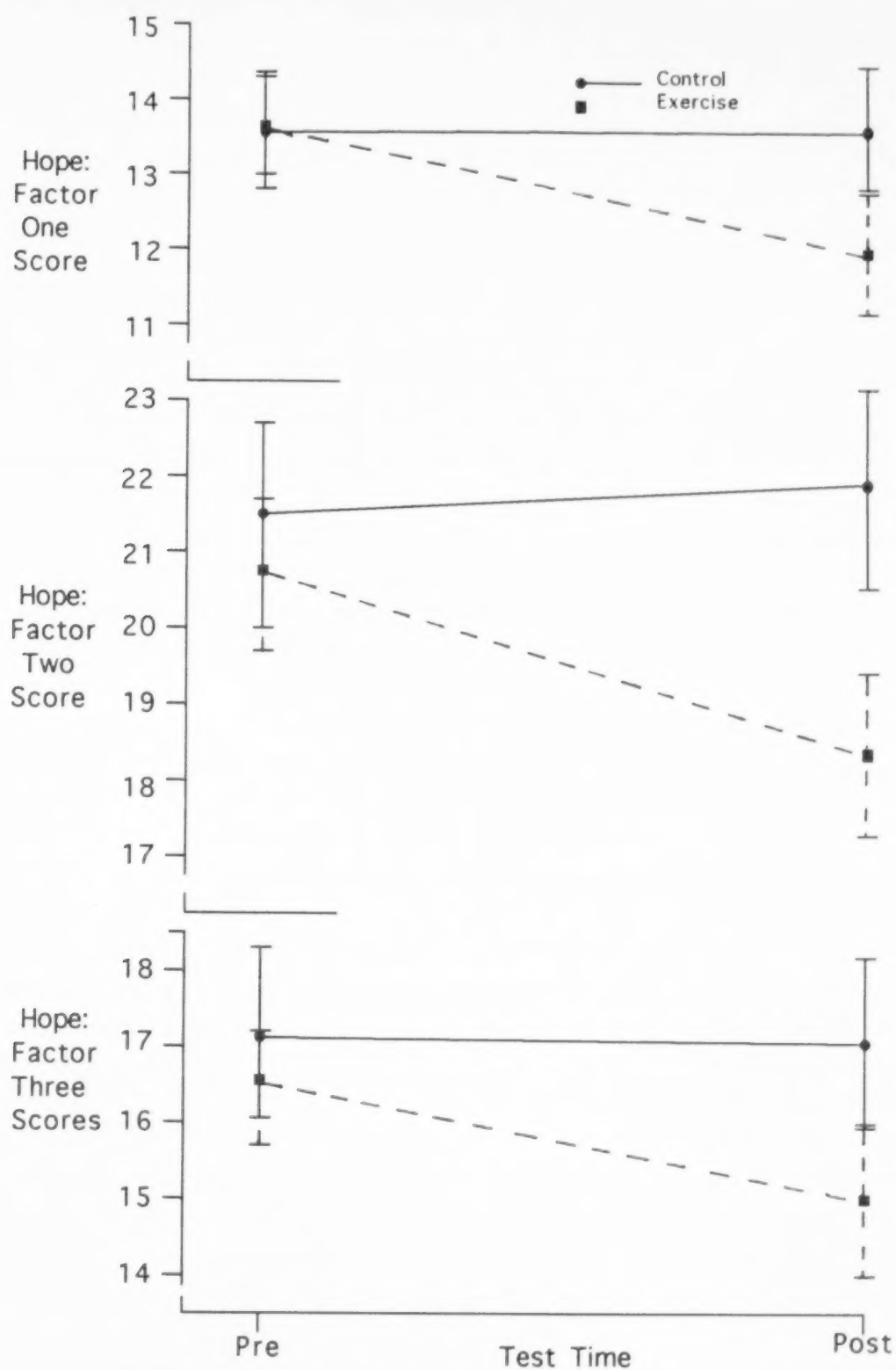


FIGURE 24: The Effect of an 8 Week Program on Hope: Factor One, Two, and Three

b) Factor 2: Mutuality or Relationship with Others, and Sense of Personal Competence

Composed of twelve items, Factor 2 includes questions such as "I know I have deep inner strength", "I have help and support from other people close to me", and "I feel angry and overwhelmed" (reverse scoring). As these three examples suggest, Factor 2 contains more items that are generalizable and do not imply a specific threat to the individual than Factor 1. However, this did not appear to affect the results. As with the total hope score and the Factor 1 score, the ANOVA revealed a statistically significant difference between groups and over time ($p < 0.05$). As with Factor 1, the Exercise group's mean Factor 2 score exhibited a significantly greater change over time than did the Control group ($p < 0.05$). The mutuality (or relationship with others) and sense of personal competence mean score for the Exercise group decreased by 2.4 (an increase of 11.5% in mutuality and personal competence), from a mean pre-intervention score of 20.7 to a mean post-intervention score on Factor 2 of 18.3. Conversely, the Control group's mean score increased (by 0.5, indicating a 2.3% decrease in mutuality and sense of competence) from a mean pre-intervention score of 21.4 to a mean post-intervention score of 21.9. In the present study, the exercise intervention appears to be associated with an improvement in mutuality and sense of personal competence.

Regression Analysis

Statistical significance for correlations was accepted at the 0.05 level.

Summary of Results for Significant Correlations with Hope: Factor 2

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	Global Self-Esteem	11.894	0.459
Control Post-	Global Self-Esteem	37.135	0.726
Exercise Pre-	Global Self-Esteem	18.591	0.522
Exercise Post-	Global Self-Esteem	29.814	0.637

As with hope Factor 1, the only statistically significant correlations that emerged involving hope Factor 2 also involved self-esteem. Significant correlations occurred for both groups pre- and post-intervention. The correlation between hope Factor 2 and self-esteem improved over time for the

Exercise group (the percentage of variability accounted for by the two variables increased from 52% to 64%). The scattergrams revealed hope Factor 2/self-esteem scores that were less scattered around the regression line at post-intervention. However, the scores were slightly more clumped at post-intervention in the Exercise group.

The Control group exhibited a similar but more marked improved correlation over time the percentage of variability accounted for by the two variables increased from 46% to 73%). The scattergrams revealed hope Factor 2/self-esteem scores that were more linear and less clumped at post-intervention for the Control group. These results suggest that over time, the relationship between hope Factor 2 (Mutuality or Relationship With Others and Self-Competence) and self-esteem strengthened in the Control group as well.

These results suggest that the exercise program was not associated with improved relationship between global self-esteem and hope: mutuality or relationship with others and self-competence; the improvement occurred in both groups.

c) Factor 3: Temporality of Present Situation with Future Orientation

As its title suggests, the items in Factor 3 address how the respondent views his or her future. For example, items include statements such as "I have made specific plans for today and the next week", "I feel scared about my future" (reverse scoring), and "I believe each day has the potential for being better." Like those in Factor 2, the items in Factor 3 are generalizable; all can be interpreted as referring to everyday experience without reference to an event or condition that poses a threat to the respondent.

A statistically significant improvement in this Factor was indicated over time but not between groups ($p < 0.05$). But like the results for Factor 1 and Factor 2, the mean change in the Exercise group at post-intervention was substantial while the mean change in the Control group at post-intervention was marginal. The Control group's mean Factor 3 score decreased by 0.125 (an increase of 0.7% in temporality of present situation with future orientation) from a mean pre-intervention score of 17.2 to a mean post-intervention score of 17.1. The Exercise group's score moved in a similar direction, but a considerably greater degree. From a mean pre-intervention score of 16.5, the Exercise group's mean score in Factor 3 decreased by 1.5 (an increase of 8.9% in

temporality of present situation with a future orientation) to a post-intervention score of 15. The case for an association between exercise intervention and improved view of the future (Factor 3) is not as strong as that for Factor 1 and Factor 2. Changes in hope: Factor 1 (12.3% increase) and Factor 2 (11.5% increase) were significant following the exercise intervention; the increase in Factor 3 (8.9%) was not. Changes in Factor 1, 2, and 3 in the Control group over the same time period were not directionally consistent or significant (decrease in Factor 1: and Factor 2 by 0.5% and 2.3% respectively, and a .7% increase in Factor 3). It appears that exercise was associated with an improvement in hope: Factor 1 (action-oriented positive expectancy) and Factor 2 (mutuality or relationship with others, and sense of personal competence), but not in Factor 3 (temporality of present situation with future orientation) in a normal, sedentary population of women.

Regression Analysis

Statistical significance for correlations was accepted at the 0.05 level.

Summary of Results for Significant Correlations with Hope: Factor 3

<u>Group and Time</u>	<u>Parameter Correlated With</u>	<u>F-observed</u>	<u>R-squared</u>
Control Pre-	Global Self-Esteem	11.279	0.446
Control Post-	Global Self-Esteem	26.744	0.656
Exercise Pre-	Global Self-Esteem	23.445	0.580
Exercise Post-	Global Self-Esteem	18.885	0.526

As with hope Factor 1 and 2, the only statistically significant correlations that appeared in the regression analysis involving hope Factor 3 also involved self-esteem. And as with the first two Factors comprising the hope scale, a significant relationship was indicated for both groups pre- and post-intervention.

The strength of the relationship between global self-esteem and hope: temporality of present situation with a future orientation in the Exercise group decreased over time (the percentage of variability accounted for by the two variables decreased from 58% to 53%). Conversely, as with hope: Factor 1, this relationship strengthened in the Control group over time (with Factor 3, the percentage of variability accounted for by the two variables increased substantially from 45% to 66%). For the Exercise group, the scattergrams indicate that the scores were slightly more scattered at pre-intervention but were

more evenly dispersed along the regression line. At post-intervention, the scores more closely approximated the regression line. These results suggest that the exercise intervention was not associated with a substantial change in the relationship between hope Factor 3 and self-esteem in the Exercise group. For the Control group, the scattergram indicates some clumping of scores at post-intervention for the Control group. One of the outlying residuals also appears to have pulled the regression line up.

In summary, exercise appears to weaken the relationship between global self-esteem and hope: temporality of present situation with a future orientation.

DISCUSSION and SUMMARY for the Relationship Between Hope and Exercise

In the present study, exercise intervention appeared to be associated with an increase in hope as measured by the Herth Hope Scale (1989). Hope scores decreased significantly more (indicating a significantly greater improvement in hope) in the Exercise group over time when compared to the Control group in all but hope Factor 3 (Temporality of Present Situation With Future Orientation). This suggests that the exercise intervention was associated with an improved sense of hope generally, and specifically for Factor 1 (Action-Oriented Positive Expectancy), and for Factor 2 (Mutuality or Relationship With Others and Sense of Personal Competence). The changes in hope measures over time for the Exercise group versus the Control group are as follows: a 10.4% increase in hope for the Exercise group versus a 0.7% improvement for the Control group; a 12.3% improvement in hope Factor 1 for the Exercise group versus a 0.5% decrease for the Control group; an 11.5% increase in hope Factor 2 for the Exercise group versus a 2.3% decrease for the Control group; and an 8.9% improvement in hope Factor 3 for the Exercise group versus a 0.7% increase in the Control group. The three factors comprising the hope scale all improved to a similar degree and in the same direction in the Exercise group while the changes in hope in the Control group were not significant or directionally consistent. As was mentioned previously, this argues for an association between exercise intervention and improved hope.

Miller and Powers cite physical activity as an important element in hope (1988). Theirs, however, is the only research found that refers to physical activity specifically as a contributor to hope.

Four factors may contribute to the observed improvement in hope following exercise: increased self-competence (or, as Herth refers to it, sense of personal competence), improved coping strategies, greater optimism, and increased mutuality or relationship with others. Physical competence in the Exercise group increased significantly in the present study; this change may have mediated the improvement in hope noted following exercise. Increased physical competence may have generalized to a greater sense of personal competence (an important element in Factor 2 of Herth's Hope Scale) and self-concept. According to Ryan (1989) and Thoreson and Eagleson (1983), exercise can improve general self-concept by improving sense of personal competence. The qualitative, written responses in the present study suggest that this was the case. For example, the respondents indicated that simply participating in the exercise program improved their perception of self-competence. Other researchers have reported similar results (Ewart et al. 1983; Harter, 1982; Marsh et al., 1983; Marsh and O'Neill, 1986; Roviario et al., 1984; Ryckman et al., 1982; Safrit et al., 1986; and Taylor et al., 1985). A large body of research also indicates that exercise intervention can improve global self-concept directly (Hatfield et al., 1985; Hughes et al., 1984; MacMahon and Gross, 1986; MacMahon and Gross, 1987; Ossip-Klein et al., 1989; Perri and Templer, 1985; Roviario et al., 1984; Short et al., 1984, and Trujillo, 1983).

The written responses revealed another element of self-competence associated with exercise that may contribute to the observed improvement in hope. The participants cited a sense of achievement associated with : 1) initiating, on their own, the action to participate; and 2) adhering to the exercise program. This suggests that hope may have increased as the program progressed; as Staats asserts, "...persons with hope seem more likely to initiate activities (e.g. help-seeking) and are more likely to persist in such activities once initiated" (Staats, p. 366, 1989). Herth (1989) and Stotland (1969) agree that hopefulness is a prerequisite to action; hope may have increased as the participants persevered with the program. And the sense of achievement associated with participation in the exercise program may have increased their sense of personal competence, and therefore hope.

Exercise may also serve to increase hope by contributing to effective stress management strategies. Increased ability to cope under stress is a well-documented result of participation in an exercise program (Archer, 1988; Long, 1986 and 1987; Long and Haney, 1987; Morgan, 1985; Ossip-Klein, 1989;

Ryan, 1989; Sternlicht, 1980; Thoreson and Eagleston, 1983; Wheeler and Frank, 1988). Exercise's anxiety-reducing function may contribute to hope, and hope itself is cited as an effective stress buffer (Frank, 1975; Obayuwana, 1980; Pelletier, 1977; Simonton et al., 1978 and 1980; Herth, 1989; Miller and Powers, 1988; and Obayuwana and Carter, 1982). According to a number of investigators, hope not only counteracts the symptoms of stress but functions to reduce anxiety and increase the individual's ability to cope with stress (Frank, 1975; Obayuwana, 1980; Pelletier, 1977; Simonton et al., 1978 and 1980). Herth's Hope Scale is well correlated with level of coping (measured with the Jalowiec Coping Scale). Because stress is a factor in everyday life, the significant improvement in hope following exercise intervention evident in the present study may indicate an increased ability to cope with stress following exercise intervention. According to the written, qualitative responses, the majority of participants managed stress and anxiety better following the exercise intervention.

Like those in the present study, results from Wheeler and Frank's (1988) work analysing the veracity of various stress buffers point to an association between exercise and hope. Although they do not refer to hope directly, in their list of four "true" stress buffers (derived from discriminant analysis conducted with data from 700 participants), Wheeler and Frank (1988) cite two components implicit in hope (Herth, 1989; Miller and Powers, 1988; McGee and Clark, 1984; Obayuwana and Carter, 1982): 1) a sense of competence; and 2) a sense of purpose. The other "true" stress buffers, according to Wheeler and Frank (1988), are exercise pattern and leisure activity.

Optimism is an integral part of hope; exercise may have contributed to increased hope in the present study by increasing the participants' perception of optimism. The written, qualitative responses in the present study suggest that increased optimism resulted from participation in the exercise program.

During the exercise program, the participants developed friendly relationships with one another based, in part, upon the fact that all were at similar levels of experience in physical activity and all had an interest in the exercise program (this was suggested in the written qualitative responses). This may have contributed to Factor 2: Mutuality or Relationship with Others. As Jarnoski (1981) and others have found, social factors in an exercise program may contribute to greater global self-esteem; it is possible that these factors can increase level of hope as well.

It is noteworthy that in the present study, no significant change in hope Factor 3 (i.e. temporality of present situation with future orientation) was observed. The Herth Hope Scale has been used in studies involving people faced with substantial immediate threat (e.g. individuals with cancer, etc.). Implicit in this Hope Scale is the prospect that the assessee faces a threatening situation. "Temporality of present situation" suggests a greater focus upon the element of threat in Factor 3 than in the other two factors. However, all three factors contain at least two questions that refer to a difficult situation the assessee currently faces. Because the participants in the present study were not facing a threatening situation, Miller's Hope Scale may have been a more appropriate tool for measuring hope. However, due to time constraints, it was difficult to fulfill the requirements necessary in order to use this scale (i.e., the internal consistency alpha coefficient of the MHS with the present study's sample).

It has been noted that increased optimism was observed in the responses to the written, qualitative questions following exercise intervention. Optimism is implicit in Factor 3, but this optimism refers to a future context. Perhaps the greater optimism reported by the exercise program participants did not extend to optimism (in terms of planning) for the future, as is referred to in the Factor 3 statements. Increased optimism in the present situation following exercise intervention was suggested, however, by the significant improvement in "action-oriented positive expectancy" (Factor 1).

Explanations for the significant change in hope Factor 1 and 2 scores in the Exercise group have already been suggested. Along with improved self-competence (or personal competency) and optimism in the present, the exercise intervention in the present study may also be associated with improved coping strategies. Increased ability to cope under stress is a well-documented result of participation in an exercise program (Sternlicht, 1980; Thoreson and Eagleston, 1983; Wheeler and Frank, 1988; Archer, 1988; Morgan, 1985). Exercise's anxiety-reducing function may contribute to hope, and hope itself is cited as an effective stress buffer.

The regression analyses revealed an interesting pattern; hope and self-esteem appear to be correlated in all groups and over time. Interestingly, the exercise intervention does not appear to strengthen the correlation. In fact, over time, the correlation between hope and self-esteem in the Control group appeared to strengthen. These findings suggest that in the present study,

exercise does not contribute to a stronger relationship between hope and self-esteem.

The relationship between self-esteem and hope is referred to by other researchers; in his article "Hope and Other Deterrents to Illness", Gottschalk states that "goal-directed behaviour, high self-esteem, or the absence of grief or other pathological depression" have effects that are congruent with hope (p. 515, 1985). In defining hope, Obayuwana and Carter (1982) asserted that assurance and confidence are essential to hope. Assurance and confidence are key elements in a sense of self-worthiness, or self-esteem. In their study (1986) with university students, Stassen and Staats reported that self-esteem (measured with the same test used in the present study) exhibited the highest correlation with their Hope Index.

Results from the present study indicate that a sense of personal worthiness (or global self-esteem) increases as hope increases. Hope is comprised of both internal and external factors; perhaps global self-esteem is a key component of hope. Results from the present study suggest that for sedentary women, self-esteem appears to be part of the hope construct. As Gottschalk (1985) states, high self-esteem may be "congruent with hope".

In recruiting participants for this study, potential participants were told that those randomly assigned to the Control group would receive the same exercise program of the same duration following the program conducted for the Exercise group and the post-intervention testing period. It is possible that the anticipation of engaging in the program may have affected the results observed for hope in the Control group in the present study. However, hope measures in the Exercise group were significantly greater than those in the Control group at post-intervention; this suggests that the exercise program was associated with a significantly greater improvement in hope, even with consideration to the anticipation factor postulated for the Control group.

V. SUMMARY and CONCLUSIONS

In the present study, exercise was associated with improved scores for suprailiac skinfold measures, push-ups performed, sit-ups performed, predicted V02 maximum, physical self-efficacy (including self-efficacy for aerobic dance/exercise, stair-climbing, and lifting designated weight), physical competence, physical acceptance, and hope in the present study. These results do not corroborate Sonstroem and Morgan's theory; self-esteem did not increase significantly following exercise intervention in previously sedentary women. The alleged precursors to self-esteem improved significantly following exercise intervention; however, increased physical self-efficacy, physical competence, and physical acceptance did not generalize to significantly increased self-esteem.

The exercise program may not have been long enough to realize a significant change in global self-esteem; perhaps significant changes in self-esteem would follow from a program of 15 to 20 weeks, as suggested by Sonstroem and Morgan (1989). In addition, perhaps assessment after a longer period of time (i.e. 6 months and more) may reveal changes that were not evident immediately following the exercise program.

Self-esteem is a multi-faceted and complex construct. Perhaps the theory that exercise participation can improve global self-esteem is simplistic. It may be critical to determine how important physical self-concept is to the participant when assessing the relationship between exercise and global self-esteem, as suggested by Sonstroem and Morgan and others. Additionally, it may be worthwhile to determine the value participants place upon the elements of global self-concept (i.e. social, physical, intellectual, emotional, spiritual, moral/ethical) in future investigations of the relationship between exercise and global self-esteem.

Regression analysis results in the present study tended to suggest that no intervention better predicted relationship between physical self-efficacy, physical competence, physical acceptance and global self-esteem. It is important to note, however, that the activity levels of the participants in the Control group were not monitored. Although they were asked to maintain the same activity level (i.e. sedentary) during the eight week intervention that the participants had prior to taking part in the study, it is possible (and a number of participants alluded to this) that the Control group participants increased their

activity level as the spring turned to summer. To circumvent this problem, the study could be conducted during the winter (to minimize the ease and possibility of increasing activity levels) and the control group could be asked to maintain a weekly diary of any activity they engage in during the intervention period.

Factors in the exercise program itself may have contributed to the results observed in the present study. It would be insightful to measure the effect of feedback, mutuality or relationship with others, and body awareness upon the self-conception variables in Sonstroem and Morgan's model.

It may be very worthwhile to consider and incorporate a social learning perspective into the model describing the relationship between exercise and self-esteem. Self-perceptions are very dependent upon factors in the social environment; it would be insightful in investigating the mechanisms responsible for change in global self-esteem to consider social learning as a potential mediator of change.

Locus of control did not change significantly and was not significantly correlated with any of the physiological or psychological parameters following exercise. Results from the present study suggest that locus of control does not play a role in Sonstroem and Morgan's theory and rationale for the relationship between exercise and self-esteem. Locus of control was not related to any of the parameters in the Exercise group either pre- or post-intervention.

It is difficult to ascertain whether perceived or actual changes in physical fitness were associated with improvements in psychological parameters following exercise intervention in the present study. Actual changes in physical fitness occurred, although these changes were not substantial. Perhaps participation in an exercise program alone independent of changes in physical fitness is associated with changes in psychological parameters. Informal discussion with the participants indicated that they believed that changes in physical fitness had occurred (responses to the written, qualitative questions corroborate this). Because the participants were not aware of actual changes but only perceived that changes had occurred, it may be that the perception of physical changes was as powerful or a more powerful predictor of psychological parameter changes in the present study.

Exercise was associated with an improvement in hope in the present study. This change may have been mediated by the anxiety-reducing function of exercise. Increased physical competence, physical acceptance, optimism,

and mutuality or relationship with others may also have acted to increase hope following exercise.

The consistent correlation between global self-esteem and hope over time and within groups indicates that these two parameters are indeed related. Exercise did not improve this correlation.

Researchers have alluded to self-esteem as a component of hope; perhaps self-esteem is a significant part of the hope construct.

The generalizability of results from the present study from the sample chosen is suspect. The sample size was too small to draw meaningful conclusions regarding the population and the wide age range involved probably compromised the results. It is widely known that differential predictions may result with demographic inconsistencies. It would be interesting to conduct a similar study to the present one with a sample of sedentary women of similar ages, and to repeat the study across the age range to determine whether Sonstroem and Morgan's theory applies to different age groups, and to determine whether the effect of exercise on hope is age-dependent.

It is important to note that the measure and concept of self-esteem and other self-perceptions applied in the present study are probably culture-specific.

Recommendations for future research include the following:

- 1) If a study similar to the present one is conducted, internal consistency for test measures should be established by the test-retest method prior to the collection of data.
- 2) Rather than use the same tests suggested by Sonstroem and Morgan, future investigators might employ tests specific to the group demographic involved (e.g. for age and sex). In some instances, this may require designing and validating a test (notably, a self-competence test and perhaps a self-esteem questionnaire).
- 3) Where possible, future studies should be of at least a 15 to 20 week duration. As Sonstroem and Morgan (1989) suggest, programs of longer duration are more likely to effect 'broader traits' such as self-esteem.

4) Differential prediction was probably a factor in the results found with the Herth Hope Scale. This test was designed to measure hope in a patient population. In future, a more generalized test measuring hope might be more appropriate if the subjects were a non-patient population.

5) To better investigate whether changes in physical self-efficacy, physical competence, physical acceptance, and global self-esteem occurred with actual or perceived changes in physical fitness, four groups of participants receiving various degrees of physical activity could be tested. One group would receive a mild physical activity program; one group would receive a moderate physical activity program; one group would receive a more vigorous physical activity program; and one would act as a Control group. Assuming that the mild activity program would not render significant changes in physical fitness, it might be easier to distinguish between perceived and actual physical fitness changes and which was associated with changes in psychological parameters. A questionnaire assessing participants' perceptions of physical fitness changes would also be used.

6) It is widely accepted that different prediction equations may occur with different demographic groups. Perhaps test validity for women of different ages could be established by conducting preliminary studies addressing this issue.

7) A number of the participants in the Exercise group indicated (in the qualitative, written response section) that after approximately the age of 35 years, their self-esteem improved. This raised a number of questions about the relationship between age and global self-esteem in women: is age a factor in self-esteem, and if so, how so?

To determine whether age is a factor in Sonstroem and Morgan's rationale and model for exercise and global self-esteem, a study could be conducted with a group of sedentary women comprised of every age group. Five or six groups of participants, allocated according to age (i.e. group one: 13 to 19 year-olds; group two: 20 to 29 year-olds; group three: 30 to 39 year-olds; group four: 40 to 49 year-olds; group five: 50 to 59 year-olds; group six: 60 to 69 year-olds), would engage in an exercise program. The number of participants in each group would, preferably, be over 20. A Control group would correspond in age and other pertinent features to each of the Exercise groups. As with the

present study, the four questionnaires essential to Sonstroem and Morgan's rationale and model would be administered pre- and post-intervention. The activity levels of the Control group would be closely monitored to ensure that they remain essentially sedentary. The study would be conducted during the winter months. Perhaps Sonstroem and Morgan's model would apply for certain age groups; the study design suggested here would indicate whether this was the case.

It would also prove interesting to assess locus of control and hope in women of various age groups following exercise.

8) As Rosenberg (1979), Sonstroem and Morgan (1989), and Watkins and Parks (1972) state, it may be critical to assess the importance participants attribute to physical self-concept in conducting a study such as the present one. Using a similar design to the one outlined in Recommendation 3), the value the participants confer upon physical competence and physical acceptance (components of physical self-concept) following exercise could be assessed in a number of ways:

a) The following three questions could be addressed, using a Likert scale rating: "How important are the following to you: 1. improved body image; 2. increased physical fitness; 3. improved physical function; 4. improved ability to persevere (in the exercise program)."

b) The value the participants place upon the physical acceptance and physical competence criteria in the questionnaires could be assessed by asking the question: "How important is this to you?" Weighting, using the Likert scale, could be calculated.

c) Finally, a system could be devised for scoring (pre- and post-exercise) the other components of self-concept described in Shavelson et al.'s model (i.e. intellectual/academic, social, and emotional self-concept). The value the participants place upon these components of self-concept could be compared to the value placed upon physical self-concept, results could be observed for different age groups, and regression analyses could be run with global self-esteem and other parameters to assess the relationship between all components of self-concept and global self-esteem (and other parameters) following exercise.

9) It would prove insightful to incorporate (as far as possible) an assessment of the contribution of social factors to the relationship between exercise and self-esteem. A more qualitative approach to assessment might better reflect the contribution social learning has to self-esteem.

10) Greater and more in-depth analysis of the qualitative, written responses may reveal more about the relationship between exercise and self-esteem.

11) Perhaps Sonstroem and Morgan's model could be tested for culture specificity. It is possible that self-perceptions assessed in the present study, notably physical competence, physical acceptance, and perhaps self-esteem, are very different across cultures. It would be insightful to investigate whether measures of self-conception are perceived differently in various cultures.

12) Miller's Hope Scale might be used in other studies assessing hope in non-threatened populations. This might render different results for the regression analysis between hope and global self-esteem following exercise. In any case, internal consistency alpha coefficient of the scale used with the study sample would first need to be done.

13) A factor analysis could be run with items from the Herth Hope Scale and items from Rosenberg's global self-esteem scale to determine which items appear to be related.

14) A study similar to the present one could be conducted with a group of women facing a threatening situation, such as women with cancer, women who have been battered, etc. In these cases, the Herth Hope Scale would be appropriately applied. It would be interesting to see if Sonstroem and Morgan's model and rationale apply in a situation where women face a threat to their physical person; perhaps an improvement in physical self-concept would more readily mediate an improvement in global self-esteem if the participant's physical person is compromised in some way.

15) Perhaps assessment after a long period of time (i.e. at 6 months and more) would reveal changes in self-conception measures that were not evident

immediately following the exercise program. Future studies might incorporate a long-term follow-up to address this.

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APPENDIX A

CALIBRATION PROCEDURES

Appendix A

Calibration of the Monark Cycle Ergometer

The cycle ergometer test was carried out on a calibrated Monark Ergometer which works on the principle of variable resistance mechanically braked and uses a weighing device called a sinus balance. The amount of work done (in kilopond meters or kpm) is a function of the braking power (measured in kiloponds), set by the adjustment of the belt tension, and multiplied by the distance pedalled (m). The loads on the bike ergometer are reproducible if the ergometer is calibrated regularly. The sinus balance was calibrated by means of a set of stainless steel weights in the following manner:

- a) The fly wheel was loosened and pushed back so that the light spring supporting the weight hung freely.
- b) The string was kept clear of the wheel and the scale measuring the pendulum weight was checked to ensure that it read "0" with no weight on the string.
- c) A one kilogram weight was attached to the spring. Weights were added or taken from the spring as required to bring the mark on the pendulum to the required scale mark of "1-kp."
- d) The process outlined in c) was repeated for the scale divisions 1.5 kp, 2.0 kp, 2.5 kp, 3.0 kp, up to 5.0 kp.
- e) If adjustment was required it was made by means of an adjusting screw which altered the center of gravity of the sinus balance.

APPENDIX B

SUBJECT PREPARATION, TEST PROCEDURE, PREDICTION OF OXYGEN
CONSUMPTION, AND DETERMINATION OF PHYSICAL WORK CAPACITY

Appendix B

Subject Preparation

- 1) A Sport-tester designed to measure and record heart rates during exercise (using electrodes to pick up the heart's electrical activity) was adjusted to fit the subject and was placed on for a five minute period.
- 2) The resting heart rate was recorded.
- 3) Resting blood pressure was measured (using a sphygmomanometer and stethoscope) and recorded.
- 4) The height of the seat saddle on the bike was adjusted so that when the subject had the front part of the sole of her foot on the pedal, a slight bend of the knee joint resulted in the extended leg and the front part of the knee was straight above the tip of the toes.
- 5) The subject was allowed to warm up and familiarize herself with the apparatus for two minutes at a 300 kpm work level which was followed by a five minute rest interval.

Test Procedure

- 1) The subject began pedalling and resistance was put on the flywheel to 0.75 kps for the first 30 seconds to one minute to assess the affect on the heart rate. As soon as the resistance was put on the flywheel, the subject was asked to maintain their pedalling cadence at 60 revolutions per minute (the rpm value could be observed by the subject on the bicycle ergometer) and the timer was started.
- 2) The workload was adjusted to achieve a heart rate between 115 and 130 beats per minute by the end of the first four minutes. The experimenter reminded the subject to maintain the 60 rpm pace where necessary. The resistance was adjusted as necessary to achieve the target heart rate. Heart rate, rpm, and resistance were recorded at the end of each minute.
- 3) Between minute four and minute eight, the workload was adjusted to achieve a heart rate between 140 and 155 beats per minute by the end of eight minutes. The resistance was adjusted as necessary to achieve the target heart rate. Heart rate, rpm, and resistance were recorded at the end of each minute.

- 4) Between minute eight and minute twelve, the workload was adjusted to achieve a heart rate between 160 and 180 beats per minute by the end of 12 minutes. The resistance was adjusted as necessary to achieve the target heart rate. Heart rate, rpm, and resistance were recorded at the end of each minute.
- 5) If at any time the subject complained of dizziness, exhaustion, excessive pain, or nauseousness, or if the experimenter noticed the subject took on a pallid appearance, the test was immediately terminated.
- 6) Following the twelfth and final minute of work, post-test blood pressure was taken (using the sphygmomanometer and stethoscope). The subject was allowed as much time as they deemed necessary to cool down on the bicycle.

Determining Physical Work Capacity and Predicting Oxygen Consumption

- 1) The workload for the fourth, eighth, and twelfth minutes was determined by multiplying the average workload (kp) for the four minute exercise period by the average number of pedal revolutions for the same period.
- 2) The mean workloads were plotted against the mean exercise heart rates for the fourth, eighth, and twelfth minutes on the Physical Work Capacity nomogram (see Appendix page following).
- 3) A line of best fit was drawn connecting the three points plotted in #2). The PWC was estimated from the point at which this line intersected the horizontal line denoting a heart rate of 170 beats per minute.
- 4) A vertical line drawn vertically down from the point of intersection to the scale denoting maximal volume of oxygen consumption indicated the predicted maximum VO_2 .
- 5) The predicted maximal volume of oxygen consumption was modified for age by multiplying the predicted VO_2 by an age correction factor for subjects over 25 years of age (see page following for Astrand's table of Age Correction Factors).
- 6) The estimated VO_2 maximum was then converted from absolute (Litres per minute) to relative terms (ml/kg/min) by factoring in body weight.

APPENDIX C

PROCEDURES FOR TAKING SKINFOLD MEASUREMENTS

Appendix C

Procedure for Taking Skinfold Measurements

- 1) The skin was grasped between the thumb and forefinger. The skinfold included two thicknesses of skin and subcutaneous fat, but excluded muscle and fascia.
- 2) The calipers were applied approximately one centimeter below the fingers holding the skinfold, at a depth equal to the thickness of the fold.
- 3) Each fold was taken in the vertical plane while the subject was standing, except for the subscapular and suprailiac which were taken on a slight diagonal.
- 4) The anatomical landmarks for the eight skinfold sites were taken as follows:

Tricep:

This measurement was taken at the back of the upper arm, at the midpoint between the shoulder and the elbow. The arm was relaxed loosely at the side and the skin was lifted parallel to the long axis.

Bicep:

This skinfold site was located at the front of the upper arm, with the arm flexed at 90 degrees. The site was marked at the midpoint between the greater tubercle of the humerus and the fold of the bent elbow. The arm was then relaxed loosely at the side and the skin was lifted parallel to the long axis.

Subscapula:

This site was marked below the tip of the bottom of the shoulder blade (scapula). The thumb was placed on the tip of the shoulder blade and rotated clockwise, vertically lifting the skinfold between the thumb and the forefinger.

Iliac Crest:

This measure was taken from the point where the iliac crest (hip bone) can be palpated.

Suprailiac:

This skinfold was taken just above the top of the hip bone (crest of the ilium) at the middle of the side of the body. The thumb was placed on the iliac crest, with the forefinger lifting the fold along a slight vertical angle, coinciding with the normal fold line.

Abdominal:

This site was marked and taken approximately two centimetres to the side of the navel. Measurements were taken by lifting the skinfold parallel to the long axis of the body.

Front thigh:

This skinfold was taken from the middle front side of the thigh midway between the patella and the hip, parallel to the long axis of the leg. To relax the quadriceps muscle, the foot was elevated and the knee flexed slightly.

Medial calf:

The leg was placed on a stool to relax the calf muscle. The skinfold was lifted parallel to the long axis of the leg at the greatest circumference of the rear calf.

APPENDIX D

PROCEDURES FOR TAKING GIRTH MEASUREMENTS

Appendix D

Procedure for Taking Girth Measurements:

Eight girth measurements were taken following the procedure described by Brozek (1961b) and Sloan et al. (1962). Even pressure was applied on the girth measure tape without compressing the underlying tissue. The measurements were made while the subject was standing. Sites measured are described below:

Waist (abdomen):

This measurement was taken at the minimal abdominal girth, above the top of the hip bone and below the rib cage.

Hip (gluteals):

This measurement was taken at the maximum circumference of the hip at the gluteal prominence. Feet were together for this measure.

Chest:

This measurement was taken at the fullest part of the bust and at the midpoint of a normal breath.

Calf:

This girth was taken at the maximal circumference.

Biceps (flexed):

The arm was held laterally at a right angle to the body. The tape measured the prominence of the flexed and contracted bicep muscle.

Elbow:

This measure was taken with the arm extended, palm facing up. The tape was placed around the elbow joint at the olecranon and lateral epicondyle.

Knee:

This girth was taken at the fullest part of the knee joint, around the patella, lateral, and medial epicondyles.

Thigh:

The tape was placed around the circumference of the thigh located just below the curve of the gluteal muscle.

APPENDIX E

QUESTIONNAIRE FOR PHYSICAL SELF-EFFICACY

PHYSICAL SELF-EFFICACY SCALES (Self-Perceived Ability to Carry Out Specific Tasks)

From Ewart et al. (1983), Gemma et al. (1988), and Taylor et al. (1985)

This is an example of a method used to calculate strength of self-efficacy. This scale measures a persons confidence or self-efficacy in their ability to tolerate a given activity. It is rated on a horizontal 10-point scale from 10% (quite or very uncertain) to 100% (quite or very certain).

Rating of Perceived Physical Self-Efficacy

10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
very				moderately				very	
uncertain				certain				certain	

<u>Walking</u>	<u>Aerobic Ex.</u> (continuous: no break)	<u>Climbing Stairs</u> (1 flight=8 stairs)	<u>Lifting</u>
1 block 5 min.	10 minutes	1 flight	5 lbs. 2.25 kg
2 blocks in 10 min	15 mins.	2 flights	10 lbs.
3 blocks in 15 min	20 mins.	3 flights	15 lbs.
4 blocks in 20	25 mins.	4 flights	20 lbs.
5 blocks in 25	30 mins.	5 flights	25 lbs.
6 blocks in 30	35 mins.	6 flights	30 lb.
7 blocks in 35	40 mins.	7 flights	35 lbs.
8 blocks in 40	45 mins.	8 flights	40 lbs.

Last scale: overall estimate of ability to tolerate physical exertion on a 6 point scale ranging from "very light" to "extremely hard"

"Please estimate your overall ability to tolerate physical exertion on the following scale:"

1	2	3	4	5	6
<u>very easy</u>	<u>easy</u>	<u>moderately easy</u>	<u>hard</u>	<u>very hard</u>	<u>extremely hard</u>

QUESTIONNAIRE #1 (Assessing Physical Self-Efficacy)

modified from Ewart et al. (1983), Gemma et al. (1988), and Taylor et al. (1985)

How certain are you that you can do the following activities in the amount of time listed? For example, how certain are you that you can walk one (1) block in 5 minutes? (circle one of the following numbers) 1 2 3 4 5 6 7 8 9 10

Where the range from 1 to 10 is:

1 = very certain 5 = moderately certain 10 = very uncertain
and anything in between!

START ANSWERING HERE: Circle the best number

1 = very certain 5 = moderately certain 10 = very uncertain

How certain are you that you can:

- 1) walk 1 block in 5 minutes: 1 2 3 4 5 6 7 8 9 10
- 2) walk 2 blocks in 10 mins.: 1 2 3 4 5 6 7 8 9 10
- 3) walk 3 blocks in 15 mins.: 1 2 3 4 5 6 7 8 9 10
- 4) walk 4 blocks in 20 mins.: 1 2 3 4 5 6 7 8 9 10
- 5) walk 5 blocks in 25 mins.: 1 2 3 4 5 6 7 8 9 10
- 6) walk 6 blocks in 30 mins.: 1 2 3 4 5 6 7 8 9 10
- 7) walk 7 blocks in 35 mins.: 1 2 3 4 5 6 7 8 9 10
- 8) walk 8 blocks in 40 mins.: 1 2 3 4 5 6 7 8 9 10

1 = very certain 5 = moderately certain 10 = very uncertain

How certain are you that you can do:

- 9) aerobic dance/exercise (continuously without a break)
for 10 minutes: 1 2 3 4 5 6 7 8 9 10
- 10) aerobic dance/exercise
continuously for 15 mins.: 1 2 3 4 5 6 7 8 9 10
- 11) aerobic dance/exercise
continuously for 20 mins.: 1 2 3 4 5 6 7 8 9 10
- 12) aerobic dance/exercise
continuously for 25 mins.: 1 2 3 4 5 6 7 8 9 10
- 13) aerobic dance/exercise
continuously for 30 mins.: 1 2 3 4 5 6 7 8 9 10

- 14) aerobic dance/exercise
continuously for 35 mins.: 1 2 3 4 5 6 7 8 9 10
- 15) aerobic dance/exercise
continuously for 40 mins.: 1 2 3 4 5 6 7 8 9 10
- 16) aerobic dance/exercise
continuously for 45 mins.: 1 2 3 4 5 6 7 8 9 10

1 = very certain 5 = moderately certain 10 = very uncertain

How certain are you that you can:

- 17) climb 1 flight of stairs without getting winded (where one
(1) flight = 8 stairs): 1 2 3 4 5 6 7 8 9 10
- 18) climb 2 flights of stairs
without getting winded: 1 2 3 4 5 6 7 8 9 10
- 19) climb 3 flights of stairs
without getting winded: 1 2 3 4 5 6 7 8 9 10
- 20) climb 4 flights of stairs
without getting winded: 1 2 3 4 5 6 7 8 9 10
- 21) climb 5 flights of stairs
without getting winded: 1 2 3 4 5 6 7 8 9 10
- 22) climb 6 flights of stairs
without getting winded: 1 2 3 4 5 6 7 8 9 10
- 23) climb 7 flights of stairs
without getting winded: 1 2 3 4 5 6 7 8 9 10
- 24) climb 8 flights of stairs
without getting winded: 1 2 3 4 5 6 7 8 9 10

How certain are you that you can: (where:

1 = very certain 5 = moderately certain 10 = very uncertain)

- 25) lift 10 lbs: 1 2 3 4 5 6 7 8 9 10
- 26) lift 20 lbs: 1 2 3 4 5 6 7 8 9 10
- 27) lift 30 lbs: 1 2 3 4 5 6 7 8 9 10
- 28) lift 40 lbs: 1 2 3 4 5 6 7 8 9 10
- 29) lift 45 lbs: 1 2 3 4 5 6 7 8 9 10
- 30) lift 50 lbs: 1 2 3 4 5 6 7 8 9 10
- 31) lift 55 lbs: 1 2 3 4 5 6 7 8 9 10
- 32) lift 60 lbs: 1 2 3 4 5 6 7 8 9 10

APPENDIX F

QUESTIONNAIRE FOR PHYSICAL SELF-COMPETENCE

QUESTIONNAIRE #2 (Assessing Physical Competence)

Harter's Perceived Competence Scale (1982)

Check the box corresponding to the statement that is most true for you. Please check only one box.

very true
for me

moderately
true for me

☐☐

Some
people are
very good
at physical
activities.

but

Others
are not
good at
physical
activities.

moderately
true for me

very true
for me

☐☐

very true
for me

moderately
true for me

☐☐

Some
people are
better at
sports than
others.

but

Others are
worse at
sports
compared
to others.

moderately
true for me

very true
for me

☐☐

very true
for me

moderately
true for me

☐☐

Some
people do
well at new
activities.

but

Others do
not do well
at new
activities.

moderately
true for me

very true
for me

☐☐

very true
for me

moderately
true for me

☐☐

Some
people are
good enough
at physical
activities.

but

Others are
not good
enough at
physical
activities.

moderately
true for me

very true
for me

☐☐

very true moderately
for me true for me

☐☐

Some people
are the first
chosen for
games.

but

Others are
not the first
chosen for
games.

moderately
true for me

very true
for me

☐☐

very true moderately
for me true for me

☐☐

Some people
would rather
play sports
than watch.

but

Others would
rather watch
sports than
play sports.

moderately
true for me

very true
for me

☐☐

very true moderately
for me true for me

☐☐

Some people
are good at
new games.

but

Others are
not good at
new games.

moderately
true for me

very true
for me

☐☐

APPENDIX G

QUESTIONNAIRE FOR PHYSICAL ACCEPTANCE

QUESTIONNAIRE #3 (Assessing Physical Acceptance)

Secord and Jourard's Body Cathexis Scale (1953)

On the following pages are listed a number of things characteristic of yourself or related to you. Consider each item listed and circle the number of each item which best represents your feelings according to the following scale:

1. have strong positive feelings
2. have moderate positive feelings
3. have no feeling one way or another
4. have moderate negative feelings
5. have strong negative feelings

appetite 1 2 3 4 5
nose 1 2 3 4 5
physical stamina 1 2 3 4 5
body scent 1 2 3 4 5
reflexes 1 2 3 4 5
lips 1 2 3 4 5
muscular strength 1 2 3 4 5
sex drive 1 2 3 4 5
energy level 1 2 3 4 5
thighs 1 2 3 4 5
ears 1 2 3 4 5
biceps 1 2 3 4 5
sex organs 1 2 3 4 5
body build 1 2 3 4 5
physical coordination 1 2 3 4 5
buttocks 1 2 3 4 5
agility 1 2 3 4 5
width of shoulders 1 2 3 4 5
arms 1 2 3 4 5
chest 1 2 3 4 5
sex activities 1 2 3 4 5
cheeks/cheekbones 1 2 3 4 5
hips 1 2 3 4 5

waist 1 2 3 4 5
chin 1 2 3 4 5
appearance of
eyes 1 2 3 4 5
weight 1 2 3 4 5
legs 1 2 3 4 5
figure 1 2 3 4 5
feet 1 2 3 4 5
appearance of
stomach 1 2 3 4 5
health 1 2 3 4 5
physical
condition 1 2 3 4 5
face 1 2 3 4 5

APPENDIX H

QUESTIONNAIRE FOR GLOBAL SELF-ESTEEM

QUESTIONNAIRE #4 (Assessing Global Self-Esteem)
Rosenberg Self-Esteem Scale (SEI)

Below are a number of statements. There are no right or wrong answers to this questionnaire; for every statement there are large numbers of people who agree and disagree, strongly or otherwise. Please indicate whether you agree or disagree with each statement as follows:

Circle SA if you Strongly Agree

Circle A if you Agree

Circle D if you Disagree

Circle SD if you Strongly Disagree

1. I feel that I am a person of worth, at least on an equal basis with others. SA A D SD
2. I feel that I have a number of good qualities. SA A D SD
3. All in all, I am inclined to feel that I am a failure. SA A D SD
4. I am able to do things as well as most other people. SA A D SD
5. I feel I do not have much to be proud of. SA A D SD
6. I take a positive attitude toward myself. SA A D SD
7. On the whole, I am satisfied with myself. SA A D SD
8. I wish I could have more respect for myself. SA A D SD
9. I certainly feel useless at times. SA A D SD
10. At times I am no good at all. SA A D SD

APPENDIX I

QUESTIONNAIRE FOR LOCUS OF CONTROL

QUESTIONNAIRE #5 (Assessing Locus of Control)
James' Locus of Control Scale (1957)

Below are a number of statements about various topics. There are no right or wrong answers to this questionnaire; for every statement there are many people who agree and who disagree. Please indicate whether you agree or disagree with each statement as follows:

Circle SA if you Strongly Agree

Circle A if you Agree

Circle D if you Disagree

Circle SD if you Strongly Disagree

1. Many times I feel that we might just as well make many of our decisions by flipping a coin. SA A D SD
2. Getting a good job seems to be largely a matter of being lucky enough to be in the right place at the right time. SA A D SD
3. It is difficult for ordinary people to have much control over what politicians do in office. SA A D SD
4. It isn't wise to plan too far ahead because most things turn out to be a matter of good or bad fortune anyhow. SA A D SD
5. When things are going well for me I consider it due to a run of good luck. SA A D SD
6. I have usually found that what is going to happen will happen, regardless of my actions. SA A D SD
7. Success is mostly a matter of getting good breaks. SA A D SD
8. There's not much use in worrying about things.....what will be will be. SA A D SD
9. Success in dealing with people seems to be more a matter of the other person's moods and feelings at the time rather than one's own actions. SA A D SD
10. I think that life is mostly a gamble. SA A D SD
11. Many times I feel that I have little influence over the things that happen to me. SA A D SD

APPENDIX J

QUESTIONNAIRE FOR HOPE

Questionnaire 6 (Assessing Hope)

Herth's Hope Scale

For the following questions, please circle the statement that best applies to you.

The statements are as follows:

SA = Strongly Agree

A = Agree

D = Disagree

SD =

Strongly Disagree

- 1) I am looking forward to the future. SA A D SD
- 2) I sense the presence of loved ones. SA A D SD
- 3) I know I have deep inner strength. SA A D SD
- 4) I feel all alone. SA A D SD
- 5) I feel scared about my future. SA A D SD
- 6) I feel immobilized by worries, fears, and doubts. SA A D SD
- 7) I have plans for my future. SA A D SD
- 8) I remember past disappointments and loss that I coped with well.
SA A D SD
- 9) I keep going even in the midst of hurting. SA A D SD
- 10) I believe a favourable outcome is possible. SA A D SD
- 11) I feel time will heal the hurting. SA A D SD
- 12) I feel angry and overwhelmed. SA A D SD
- 13) I feel at a loss and out of control. SA A D SD
- 14) I have help and support from other people close to me. SA A D SD
- 15) I believe that the future can still hold some good. SA A D SD
- 16) I know I can get on with my life. SA A D SD
- 17) I feel that others close to me don't really understand. SA A D SD
- 18) I seek the help of others when needed. SA A D SD
- 19) I can handle family and friends' reactions to the situation. SA A D SD
- 20) I believe that my faith will help me through these times. SA A D SD
- 21) I am committed to seeing my way through. SA A D SD
- 22) I know my life still has meaning. SA A D SD
- 23) I have set up goals to accomplish in the next 3 to 6 months. SA A D SD
- 24) I seek the company and support of close family and/or friends. SA A D SD
- 25) I believe that each day has potential for being better. SA A D SD
- 26) I lack belief in my ability to bring about change. SA A D SD
- 27) I feel I can carry on with life's responsibilities. SA A D SD
- 28) I see a light at the end of the tunnel. SA A D SD
- 29) I have made specific plans for today and next week. SA A D SD

APPENDIX K

EXERCISE PROGRAM: BREAKDOWN BY COMPONENT DURATION AND
FREQUENCY

Appendix K

Breakdown of the Exercise Program

<u>Time</u>	<u>Fitness Component</u>	<u>Duration</u>	<u>Intensity</u>
Week One & Two	Warm-Up	10 mins.	light
	Cardiovascular Work	10-15 mins.	easy walking
	Muscular Strength & Endurance	10-15 mins.	light
	Flexibility	10 mins.	light
	Cool-Down	10 mins.	light
Week Three & Four	Warm-Up	10 mins.	light
	Cardiovascular Work	20 mins.	moderate walking
	Muscular Strength & Endurance	20 mins.	approx. 50% more reps. than start
	Flexibility	10 mins.	light to moderate
	Cool-Down	10 mins.	light
Week Five & Six	Warm-Up	10 mins.	light
	Cardiovascular Work	30 mins.	moderate (25% jogging)
	Muscular Strength & Endurance	25 mins.	doubled # of reps. compared to start
	Flexibility	10 mins.	moderate
	Cool-Down	10 mins.	light
Week Seven & Eight	Warm-Up	10 mins.	light
	Cardiovascular Work	35 mins.	moderate to intense -power-walking, jogging 50% of time
	Muscular Strength & Endurance	30 mins.	approx. 120% more reps. than start
	Flexibility	10 mins.	moderate
	Cool-Down	10 mins.	light

Cardiovascular work involved walking and jogging; participants paced themselves according to heart rate target zones for age.

Muscular strength and endurance work involved sit-ups, push-ups, leg lift work, and wall sits.

Flexibility work involved hamstring stretches, calf stretches, arm and shoulder stretches, and trunk stretches.

Warm-up and cool-down work involved very light intensity work similar to that in the body of the exercise program (i.e. easy walking, light stretches).

APPENDIX L

GRAPHS FOR POWER OUTPUT AND MAXIMUM HEART RATE ACHIEVED
DURING THE FINAL FOUR MINUTES OF THE SJOSTRAND PWC₁₇₀ CYCLE
ERGOMETER TEST

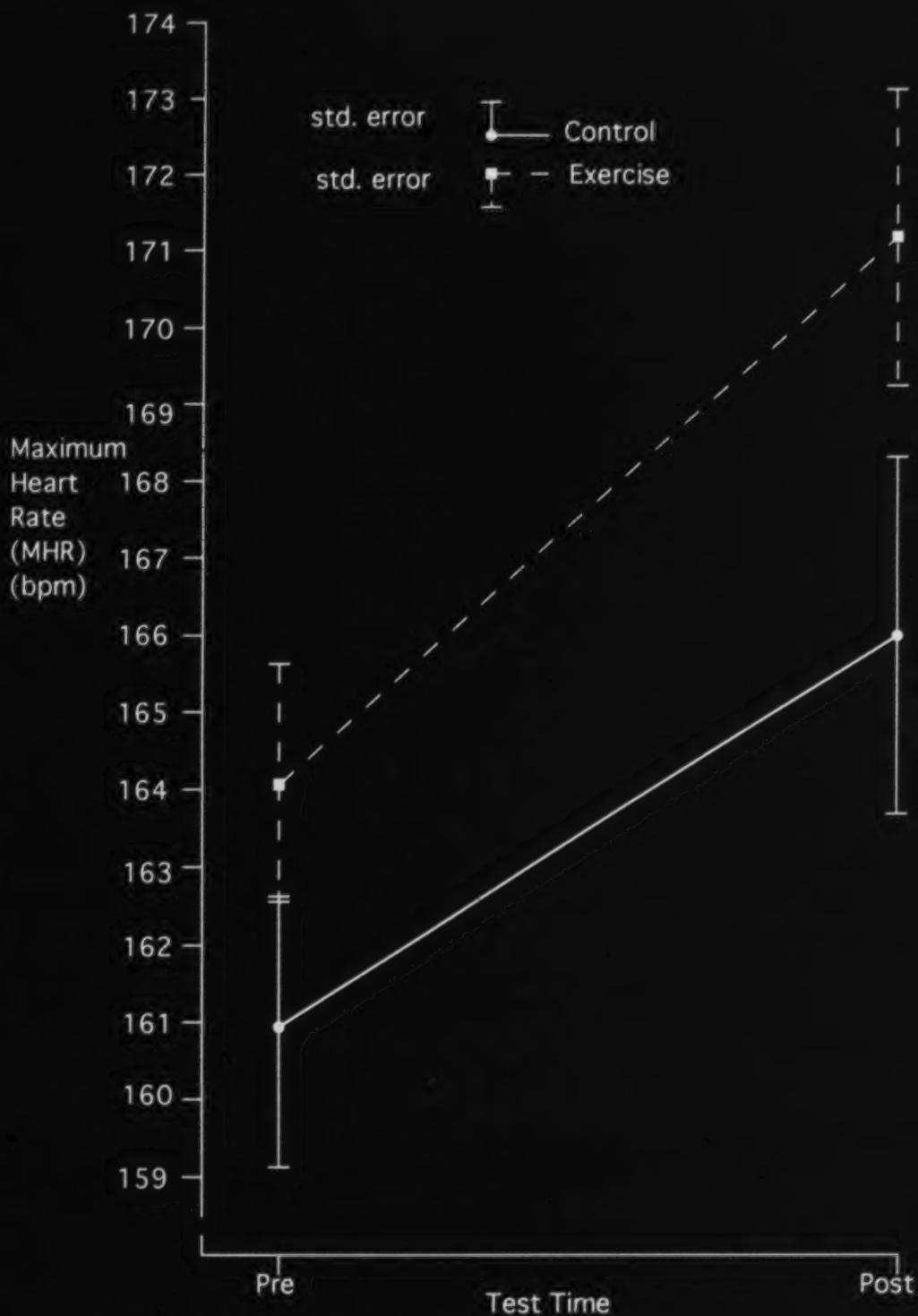


FIGURE 18: The Effect of an 8 Week Program on Maximum Heart rate Achieved in the Final 4 Minutes of Sjostrand PWC 170 Bicycle Test

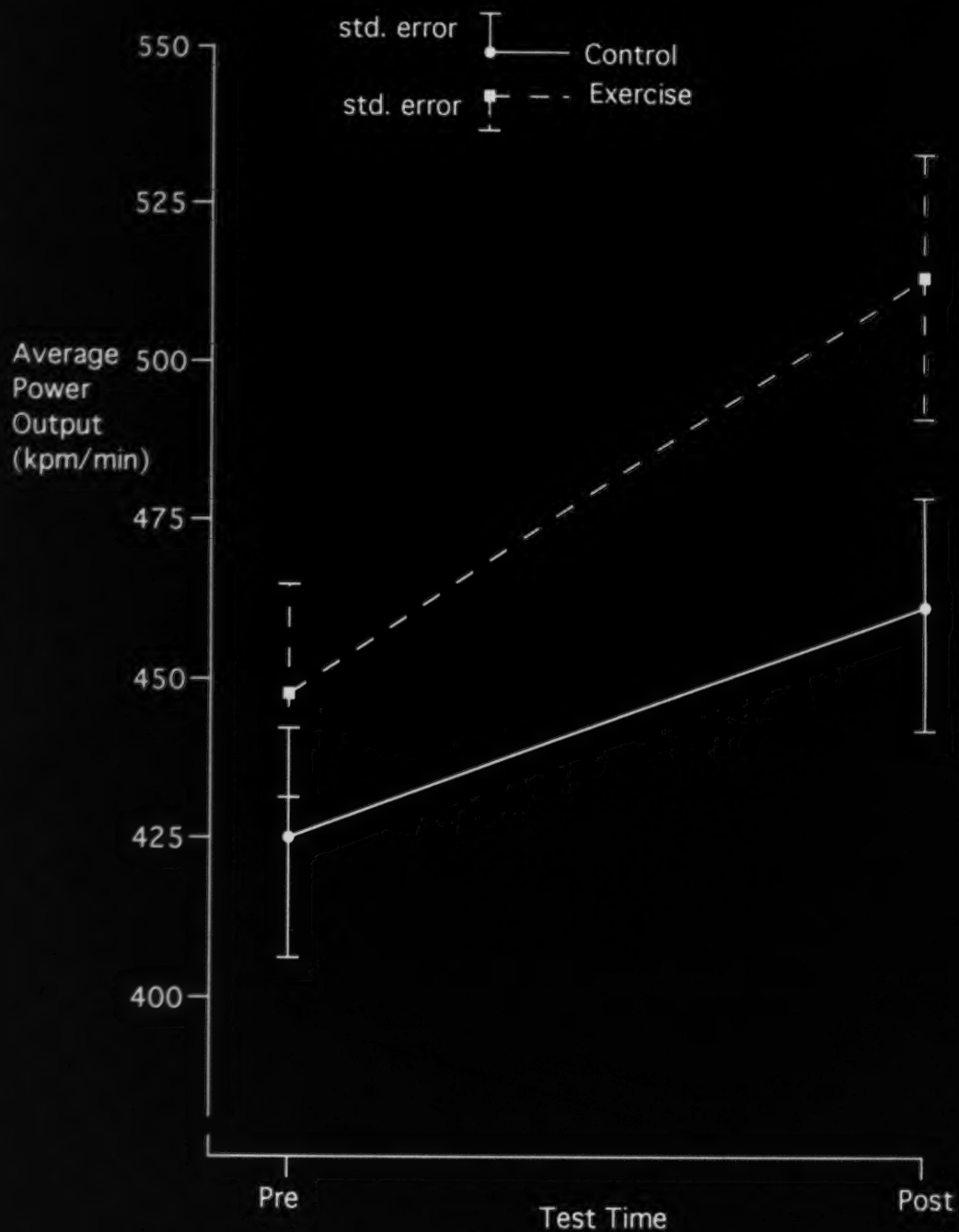


FIGURE 18: The Effect of an 8 Week Program on Average Power Output During a Sjostrand PWC 170 Bicycle Test

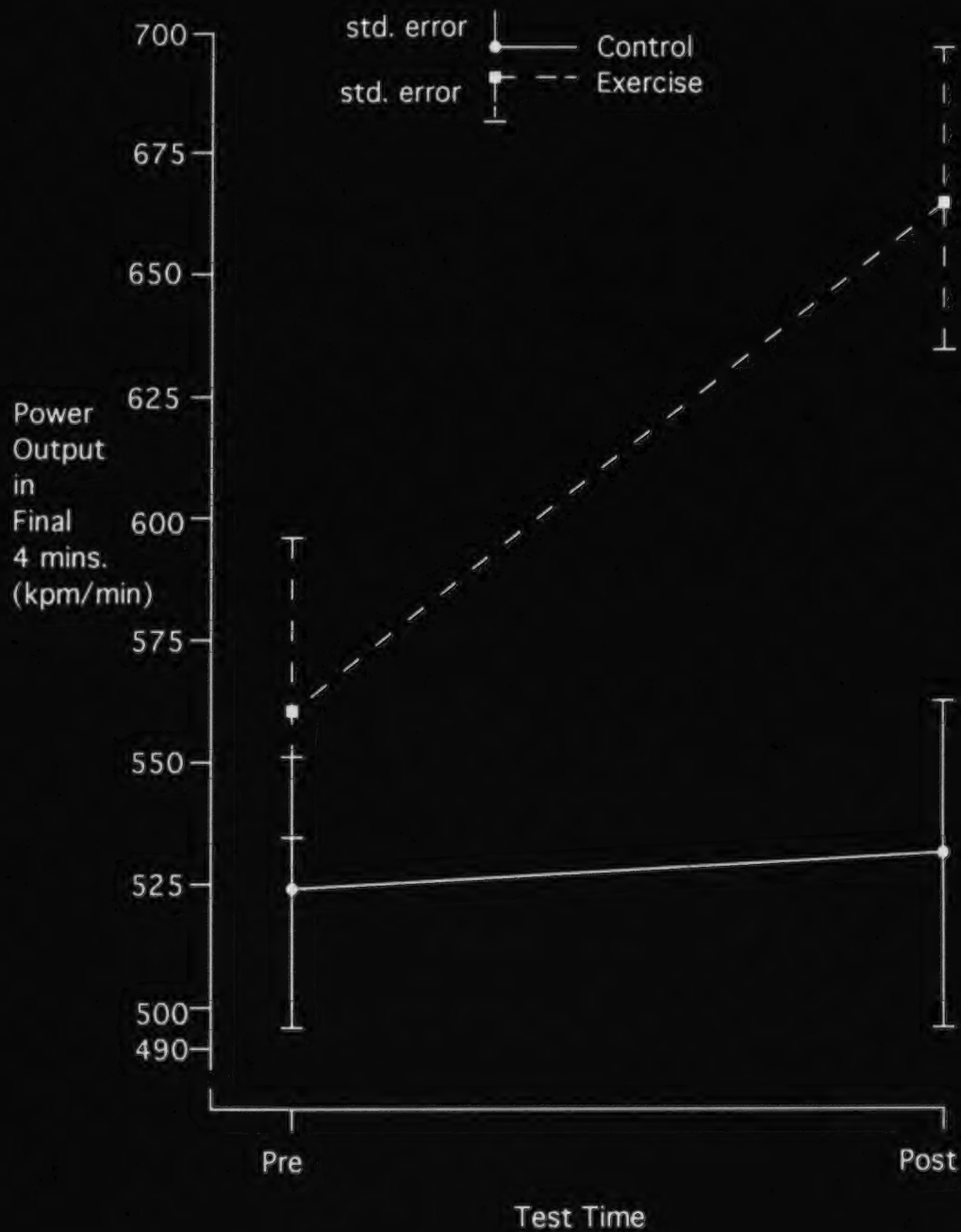


FIGURE 17: The Effect of an 8 Week Program on Power Output in the Final 4 Minutes of the Sjostrand PWC 170 Bicycle Test

APPENDIX M

COMPUTATION PROCEDURES, RESULTS, TABLE, AND GRAPHS FOR
BODY DENSITY, PERCENT BODY FAT, TOTAL BODY FAT, AND LEAN BODY
MASS

Body Composition

Body Density:

The Jackson equation developed to predict body density uses the following formula where:

A is the sum of the triceps, front thigh, and suprailiac skinfold measures;

B is **A** squared;

C is the subject's age in years.

The equation for predicting body density is as follows:

$$\text{Body Density} = 1.0994921 - 0.0009929 A + 0.0000023 B - 0.0001392 C$$

(Jackson et al., 1980)

% Body Fat:

Per cent body fat was calculated using the predicted body density value outlined by Siri. The Siri equation for determining per cent body fat is as follows:

$$\% \text{ Body Fat} = (495/1.0622991) - 450$$

(Siri)

Total Body Fat:

The per cent body fat is used to compute total body fat with the following equation:

$$\text{Total Body Fat (kg)} = (\% \text{ Body Fat}/100) \times \text{Body Weight (kg)}$$

Lean Body Mass:

Lean body mass can be calculated using the total body fat value as follows:

$$\text{Lean Body Mass (kg)} = \text{Body Weight (kg)} - \text{Total Body Fat (kg)}$$

According to Jackson et al. (1980), this generalized equation for predicting body density, body fat, and lean body mass in women has a correlation coefficient of 0.84 with hydrostatic weighing. Accuracy is reduced in women over 40 years of age (Jackson et al., 1980).

TABLE 7
EFFECT OF 8 WEEK PROGRAM ON (GROUP) BODY DENSITY, PER
CENT BODY FAT, TOTAL BODY FAT, AND LEAN BODY MASS

		GROUP			
		CONTROL (C)		EXERCISE (E)	
		PRE	POST	PRE	POST
BODY DENSITY	MEAN	1.028	1.031	1.028	1.036
% BODY FAT	MEAN	31.5	30.0	31.6	27.8
TOTAL BODY FAT	MEAN	21.7	20.4	21.7	18.8
LEAN BODY MASS	MEAN	47.1	47.5	46.9	48.7

The first body composition value calculated was body density, or the compactness of the body, equal to the body weight divided by the body volume. Jackson et al. (1980) developed an equation designed to predict body density based on skin fold thickness in women aged 18 to 55 years (please see Methodology for specific equations). Three skinfold measures are used in this equation: triceps, suprailiac, and thigh. The mean body density values for both the Control group and the Exercise group at pre-intervention were very similar (1.0279799 and 1.0277697, respectively) at the rounded value of 1.028 grams per cubic centimeter. The more exact body density values reveal that the Exercise group's mean value is slightly lower than the Control group's mean body density; this indicates that the Exercise group had less body density, or more fat tissue (which is less dense than muscle and bone) than the Control group at pre-intervention. However, following treatment intervention, the mean body density values for both the Exercise and Control groups increased.

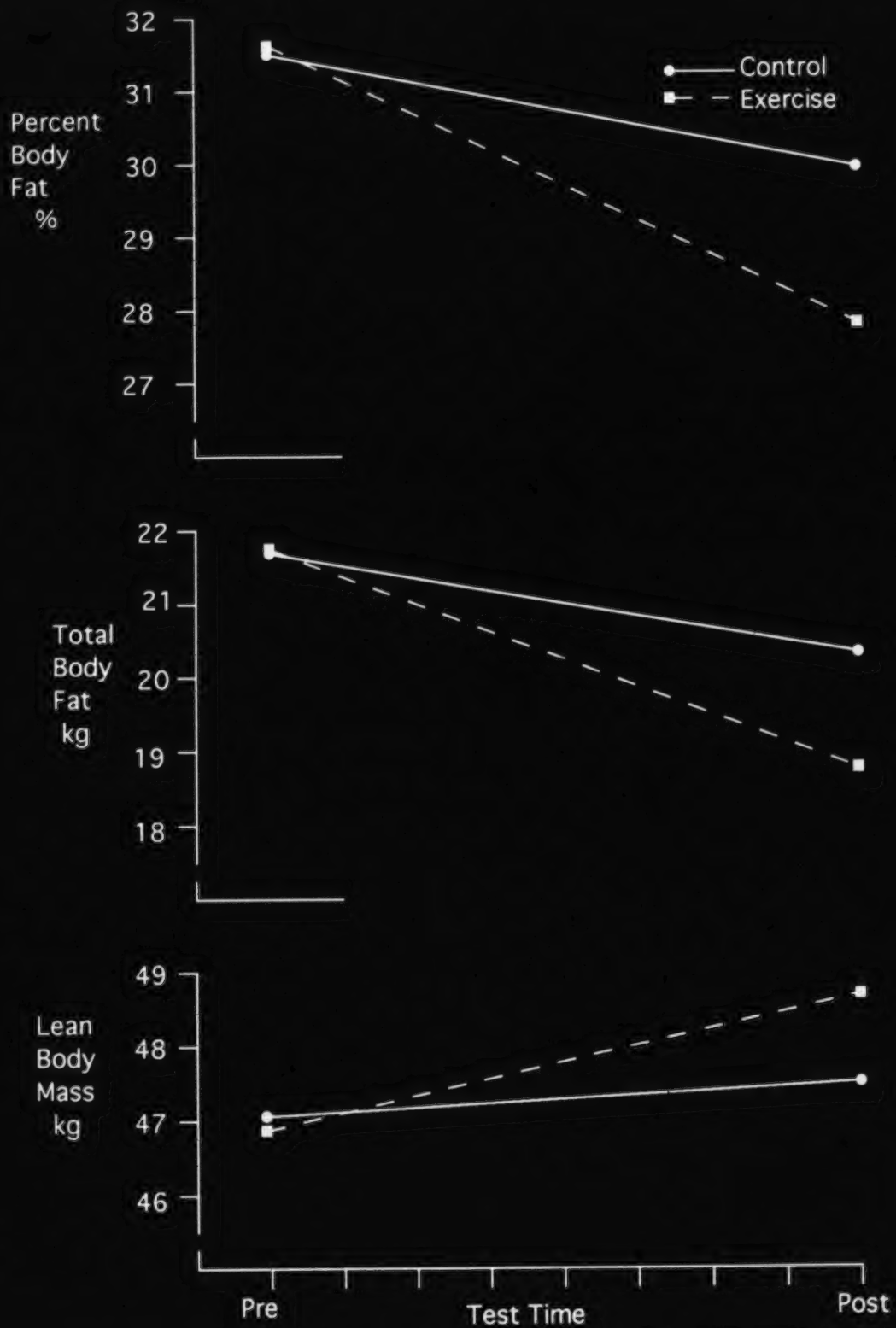


FIGURE 9: Effect of 8 Week Program on Percent Body Fat, Total Body Fat, and Lean Body Mass

The Control group mean body density value increased to 1.031 grams per cubic centimeter (an increase of 0.3% in body density). The Exercise group's mean body density increased to 1.036 grams per cubic centimeter at post-intervention (an increase of 0.8% in body density). This suggests that the exercise intervention was associated with a larger increase in body density, or the amount of dense body tissues (muscle, especially, versus fat tissue) in the Exercise group.

Following the calculation of body density with Jackson et al.'s (1980) equation, the Siri equation was applied to determine per cent body fat. Mean per cent body fat was very similar for both the Exercise and Control group at pre-intervention. The Control group had a mean pre-intervention value of 31.5% body fat. This mean value decreased to 30.0% body fat at post-intervention, a mean difference of 1.5% body fat (and representing a 5% decrease in fat tissue). Similarly, the Exercise group's mean percent body fat decreased from a pre-intervention value of 31.6% body fat to a mean post-intervention value of 27.8% body fat, a mean difference of 3.8% body fat (and a 12% decrease in fat tissue). This is a notable decrease in per cent body fat in the Exercise group and a substantially greater decrease in per cent body fat than that exhibited by the Control group. When considered with the increase in body density (an increase of 0.8% in body density) cited above, the decrease (by approximately 12%) in body fat in the Exercise group following exercise intervention is notable. While the Control group exhibited similar changes in body composition, they were not as substantial. For example, the Control group's mean body density increased by 0.3% (versus 0.8% for the Exercise group) while its mean per cent body fat decreased by 5% (versus 12% for the Exercise group).

Total body fat was calculated based upon the mean per cent body fat and the mean body weight of the groups. Mean total body fat in both the Control group and the Exercise group decreased, but the decrease in total body fat reported in the Exercise group was considerably greater. For example, both the Control group and Exercise group had a very similar pre-intervention mean total body fat value (21.7 kg). The Control group mean total body fat decreased by 1.3 kg (a 6% decrease in total body fat) to a mean post-intervention value of 20.4 kg. Mean total body fat in the Exercise group decreased by 2.9 kg (representing a 13.4% decrease in total body fat). The Exercise group exhibited

a reduction in mean total body fat that was over twice that exhibited by the Control group.

Lean body mass was calculated from the group's mean body weight and mean total body fat values. As with other body composition computations, the Control group and Exercise group both exhibited an increase in lean body mass, but the degree of increase was substantially greater in the Exercise group. The Control group mean lean body mass measure increased by 0.5 kg at post-intervention, from a mean pre-intervention value of 47.1 kg to a mean post-intervention value of 47.5 (a 1% increase in lean body mass). The Exercise group's mean lean body mass measure increased by 1.8 kg at post-intervention (a 3.9% increase in lean body mass).

It would appear possible that the Exercise group experienced substantially greater improvements in body composition following the exercise intervention based on the percent body fat data. However, no statistical analysis was run with this data, therefore no conclusions can be drawn. The following table summarizes the Body Composition data for both the Control group and Exercise group at post-intervention:

Parameter	Group	Degree of Change (%)	Amt. of Change
Body Density	Control	increased 0.3%	0.003 g/cm ³
Body Density	Exercise	increased 0.8%	0.008 g/cm ³
% Body Fat	Control	decreased 5.0%	decreased 1.5%
% Body Fat	Exercise	decreased 12.0%	decreased 3.8%
Total Body Fat	Control	decreased 6.0%	decreased 1.3 kg
Total Body Fat	Exercise	decreased 13.4%	decreased 2.9 kg
Lean Body Mass	Control	increased 1.0%	increased 0.4 kg
Lean Body Mass	Exercise	increased 3.9%	increased 1.8 kg

The Exercise group improved under all parameters by over twice the improvement exhibited by the Control group. This suggests that the exercise intervention was associated with a substantial increase in muscle mass with a concomitant decrease in fat tissue. What the body composition results also suggest is a greater decrease in body fat than an increase in lean tissue in both the Control and Exercise group. More specifically, the increase in body density (0.3% in the Control group and 0.8% in the Exercise group) and the increase in lean body mass (0.96% in the Control group and 3.9% in the Exercise group)

was less than the decrease in per cent body fat (5% in the Control group and 12% in the Exercise group) and the decrease in total body fat (6% in the Control group and 13.4% in the Exercise group). A decrease in body fat and an increase in lean body mass can be expected following exercise training. The increased caloric demands and concomitant muscular metabolism changes and cardiovascular function improvements that accompany exercise training explain the decrease in body fat and increase in body density (lean body mass) noted in the Exercise group at post-intervention. Greater lean body mass changes (higher body density) may occur with longer, more intense exercise programs.

The Control group's improvements in body composition may be due to the timing of the present study. As has been mentioned, this study was conducted between late April and early July. People tend to become more physically active during the spring and summer; perhaps the Control group became more active during the present study without engaging in organized physical activities. Informal comments from members of the Control group confirm this for a portion of the group.

As Sinning (1980) asserts, prediction equations based upon measurement of skinfold thicknesses for estimating body fat changes have many inherent limitations. It is an indirect estimate of body composition (as is hydrostatic weighing; direct assessment can only be done on cadavers). prediction equations are often not sensitive enough to detect changes in body fat following training or inactivity, and the skinfold assessor must be highly experienced to ensure validity and reliability of measures (Sinning, 1980). And as Moore (1980) states, equations for converting body density to per cent body fat were derived from direct measures of body density and body composition on white, male cadavers. Large margins of error are possible when these equations are generalized for other populations (Moore, 1980).

According to McArdle et al. (1981) and Oscai (1980), a benchmark for "obesity", although arbitrary, can be considered to be approximately 30 per cent for females. As they state, a typical 40 year old woman may have 30 per cent body fat, but this is not necessarily healthy (McArdle et al., 1981; Oscai, 1980). The obesity criterion of 30 per cent fat is one standard deviation (5 per cent) above the mean average fat tissue percentage for females (which is 25% fat) (McArdle et al., 1981; Oscai, 1980). With this benchmark criterion in mind, both the Control group and Exercise group approached the "obese" category with

mean per cent body fat values at pre-intervention of 31.5% and 31.6% respectively. The Control group remained close to this "obese" criterion at post-intervention (with a mean per cent body fat of 29.9% at post-intervention). The Exercise group's mean post-intervention per cent body fat value decreased to below the "obese" criterion (to 27.8% body fat at post-intervention).

**Body Composition: Body Density, per cent Body Fat, Total
Body Fat, and Lean Body Mass**

Body Composition (relative amounts of the structural components of the body, such as muscle, bone, and fat) was assessed by determining body density, per cent body fat, total body fat, and lean body mass. These values were not calculated for each person but instead they were calculated for each group based on mean values of skinfold measures, body weight, and age.

APPENDIX N

WRITTEN, QUALITATIVE RESPONSES:
COMPREHENSIVE RESULTS

Qualitative Responses

Qualitative responses to three questions were gathered from the Exercise group following the exercise program. The three questions were listed on the back of the final page of the questionnaires assessing psychological parameters. The Exercise group was asked to respond to the questions after they had completed the entire questionnaire. The questions were asked to address how the participants felt the exercise program had affected them (both physiologically and psychologically) or whether they felt there was any change. The aim was to use a more phenomenological approach to complement the positivistic approach to the problem addressed in the present study. Two of three of the questions were open-ended, allowing the respondents to answer as they felt fit. One-third of a page was allocated for each question and the respondent was given extra paper if necessary. The questions asked were:

- 1) This questionnaire is based upon a theory that exercise can improve self-confidence and self-esteem. Do you feel this was true for you?
- 2) What benefits did you feel the exercise program had for you personally?
- 3) Did you feel any change in your sense of 'control' over your body or in your own life attributable to the exercise we did?

Responses Question 1

Respondent

- #
- 1 Yes, definitely.
 - 3 Yes, very true. I found I was much more optimistic about the future, happier, more energetic. The exercises helped a lot. The fact that it was spring, with more light, also has something to do with it as I get S.A.D. (depressed in winter).
 - 4 Yes, I believe exercise improves self-confidence and self-esteem. I plan to continue the exercises you offered in your program and intend to reach for bigger improvements.
 - 5 Yes.
 - 6 Generally, only in areas directly related to the physical condition e.g. I am actually doing something about trying to improve my physical health, rather than procrastinating. On the other hand, it does give confidence that one can exert some control over some aspects of life, after all.
 - 8 I feel that I have improved. However, I'm unable to judge about self-confidence and self-esteem. I have always been quite confident. As far as self-esteem - that's been pretty good since I passed my 35th year (or thereabouts).
 - 10 I feel only slightly better now in the self-confidence, self-esteem area...that specifically I'm more optimistic about will-power and discipline.
 - 16 Yes, sense of overall well-being.
 - 18 Yes.
 - 20 Yes
 - 29 Yes - exercise makes me feel better, more energy, then I feel better about me. I am finally doing something positive about my body shape and condition.

- 33 Yes, to a point. I felt stronger just through the increase of exercises, and my endurance has improved, but I do believe vanity (whether we like it or not) in regards to weight and size plays a role in self-confidence and self-esteem, too.
- 34 Yes, very true.
- 35 Yes, a male friend whose opinion I value highly noticed what good shape I'm now in and commented that he thought I had lost weight. I work in a very high-stress job and coming to exercise class allowed me to let off steam and resentment - when that happened I felt better about myself. As I got more physically fit, I started to brag a bit to my less fit, sometimes overweight friends and that made me feel really good.
- 36 No I felt that way before I started.
- 37 Yes, I feel that I can physically cope better. My mental attitude was never really weak.
- 38 Yes - definitely - I'm in a size smaller jeans and they are now loose! My bum is smaller and my husband says I've lost a person already - I also feel tighter! -all these things make me feel good about myself.
- 40 Yes. (is that brief enough?)
- 42 Definitely - As I found myself developing more strength and improving my condition, I felt much better about myself.

Question 2

- 1 Capability - to do as well as classmates. Confidence -by sticking with something changes can be made.
- 3 -gave me more energy and more confidence in trying other physical activities.
- helped me feel more proud of my body, not just the way it looked but for what it could do!
- 4 The program helped me realize that I should be exercising. I felt that my overall appearance had improved.
- 5 I feel stronger, both physically and mentally. I feel I have more endurance with any physical activities I engage in.
- 6 -Being with others in the same 'condition.'
- Convenient - timing of the sessions.
- A varied program - trying out new things.
- Expert and caring tuition by someone who obviously knows what she's doing.
- Confidence in the instruction and knowing that one is getting a good grounding to continue with exercise programs and continue with exercise as a way of life.
- Great for stress management.
- 8 It improved my attitude toward physical exercise. I have always loathed to sweat and therefore have concentrated on swimming - but I found that after exercise my appetite decreased - rather than increased. This is delightful!! I found exercising in a group was fun!
- 10 Physically I am much better off! Encouraged not to get out of shape again. Reminded that it doesn't take super-human effort to stay in shape or improve. I also enjoyed participating in a class with other people.
- 16 Generally "felt better", enjoyed program and companions, some physical improvement.

- 18 More energetic.
- 20 More energy..... seem happier!
- 29 Abdomen and thighs are tightening.
- 33 Strength and endurance have improved. Really enjoyed it!
- 34 A more positive attitude. A feeling of well-being. A feeling of accomplishment.
- 35 -for the first time in my life I can do push-ups!!
 -Another benefit - no shin splints and my ankles are stronger when I'm walking.
 -A great deal of satisfaction about my slimmer waist - no pot-belly - thanks to sit-ups.
- 36 -has made me more relaxed after a day at the computer and typewriter. Better mood by the time I get home. I didn't feel as tired in the early evening.
- 37 It got me going! I became more enthusiastic about doing my "exercises". More fun with others. Felt I should keep trying (individual exercises) rather than giving up.
- 38 Toned up a lot and improved my self-esteem and they also showed me that I had "staying power"!
- 40 -an accountability to regular exercise!
 -the program was very appropriately chosen for our level.
 -lots of encouragement to do what I can; not to try to keep up to an arbitrary standard.
 -It was instructive to see sedentary older people more fit than I.
 -I appreciated seeing that different activities were significantly easier or more difficult and that this was reversed for different people.
- 42 I was able to do a lot of heavy garden work e.g. moving 4 yards of garden soil with wheelbarrow and shovel with very little after effects - hardly any stiffness or soreness.

Question 3

- 1 Yes, more positive thinking in attitude.
- 3 Yes, it was gratifying to see one's body get stronger and respond to the challenges physically.
- 4 Yes. If I continue with the exercises, I will have a firmer body and feel good about myself. Exercise is good for the mind.
- 5 Yes.
- 6 Yes, the effort that one puts into such a program (or anything, for that matter) is well worth it, and reaps results.
 -not always immediately obvious.
- 8 I found that my body could "endure" more than I thought it could - as long as my mind took a positive attitude.
- 10 Yes, more in control, but more over my mind that's needed to "drive" the body.....I also know I have the control over what my body looks like.
- 16 Somewhat more positive.
 Sense of control in general.
- 18 I have more energy and not always so tired.
- 20 Yes.
- 29 I (no one else) am doing something for myself that no one else can do for me.

33 Yes, in a number of exercises, but not necessarily in my daily life.

34 Have a feeling of positiveness - and able to do more (accomplish more).

35 Yes, before the program, I convinced myself that I could not do exercise - now I know differently - I can keep up a sustained walking low bounce aerobics program and not get winded.

36 I can wear smaller size clothes and got complements from those around me.

37 Yes, I know now that I can do it. I have become more flexible, well a little more!

38 Yes - feel that its up to me to make the changes I need to make in my life and found that if you face it straight on - it's much easier - it's great to feel in control again.

40 Not exactly, but I recognized that it would be more work to effect that control than I was expecting. I know I have that control, but through disuse, I fantasized the work easier.

42 I know I am more committed to sticking with a regular routine of exercise now that I have seen and experienced the "before-and-after".